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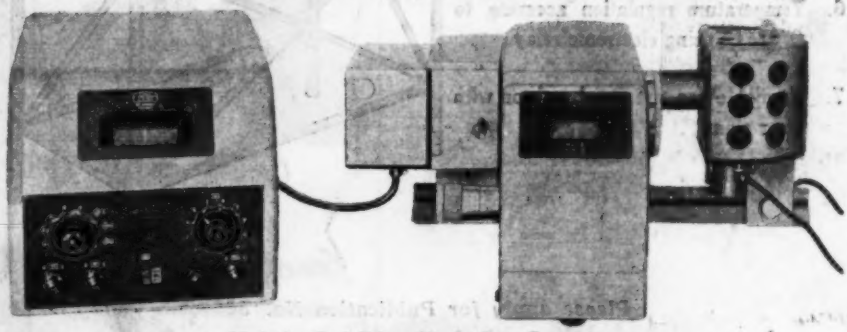

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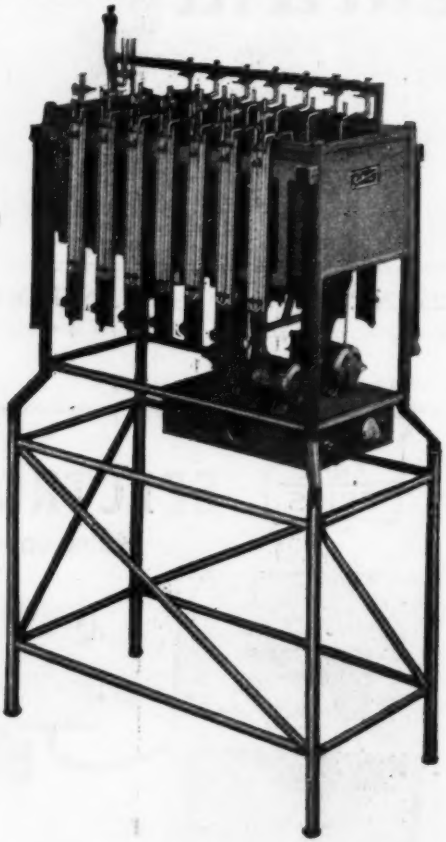

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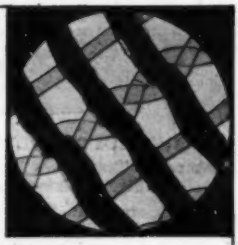

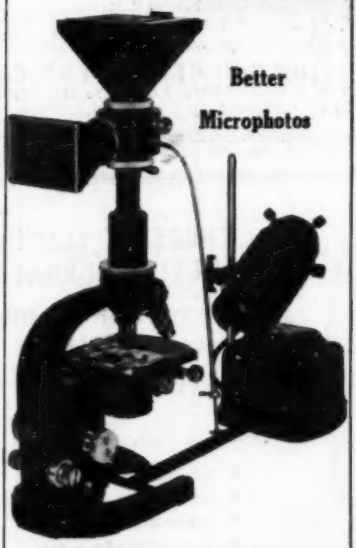

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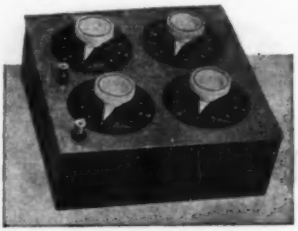

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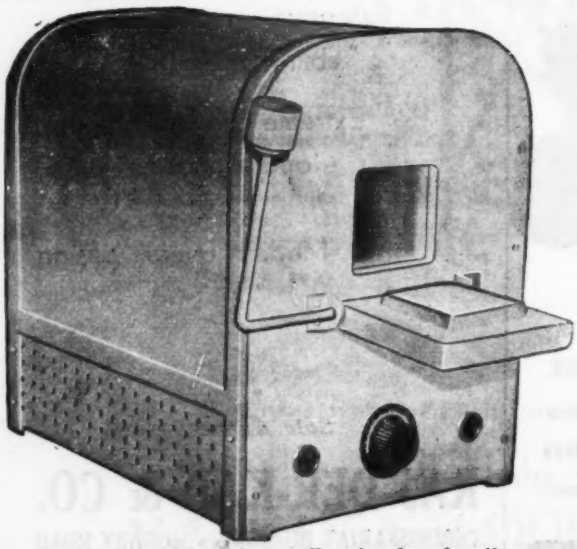

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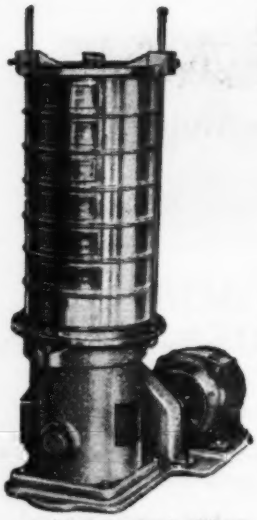

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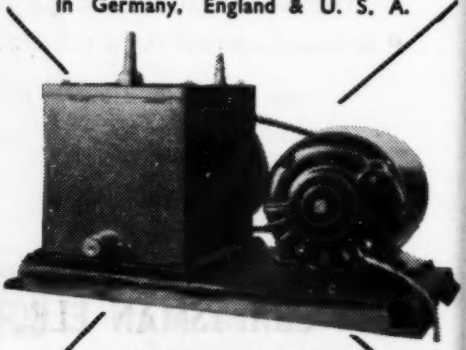

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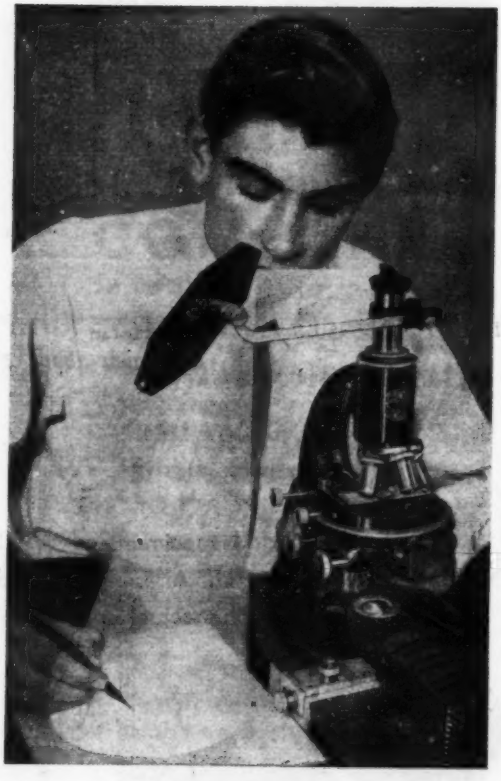

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MINERAL RESOURCES AND THEIR PROBLEMS*

FROM the dawn of human civilisation, man had used mineral products, a few at first and more as time went on. The process was slow in the beginning and even at the dawn of the Industrial Revolution, only a few mineral products were used. But during the present century, mankind has used more metals and minerals than during all its long civilised existence. Modern industry is expanding at an ever-increasing pace, and almost every country is now bent upon industrialisation, and the already industrialised countries are steadily expanding their activities. Unlike the products of the animal and vegetable kingdoms, mineral resources are not renewable seasonally or annually, and only under exceptional conditions can supplies be replenished quickly, like sulphur in areas where volcanoes are active. The only way to replace mineral deposits which have been depleted is to find new ones wherever they might occur.

The relative abundance and distribution of the elements in the earth's crust is well known, but it is not their relative abundance that matters so much as the degree of concentration and the quantity in which they are gathered up by natural processes. Such concentrates are our ore and mineral deposits. Most of the ore deposits are usually derived through the agency of magmatic processes, being associated with igneous rocks and emanations. Both the grade of the ore and tonnage have a definite relation to what we consider a workable deposit. What we call a low grade is dependent on economic considerations of winning the useful mineral first by separating it from the unwanted minerals and waste rock, and then processing or smelting it to concentrate the mineral or metal into a usable form. The average content of uranium in rocks of the crust is of the order of two parts in a million. But it will be a very costly proposition to mine half-a-million tons of rock to process it and recover 1 ton of uranium whose market value at present is roughly Rs. 35,000 to Rs. 40,000. Barely a decade ago, a workable uranium ore had to

* Abstract of the Presidential Address of Dr. M. S. Krishnan, Director, Geological Survey of India, to the 43rd Indian Science Congress, held at Agra, January 1956.

contain not less than 2% of that element. But the demand that has been created after the discovery of atomic energy makes it now worthwhile to mine and process an ore containing only 0·1% uranium.

As is well known, only a few limited areas in the world have been searched intensively for minerals. Such areas are to be found around the North Atlantic, *viz.*, in Western Europe and North America. In other parts of the world, only a few small areas have been examined in detail. The greater part of South America, Africa and Asia remain to be explored with care. In Asia and Africa there are regions which have not yet been mapped geologically. Under the circumstances, it is reasonable to expect that intensive exploration and prospecting would lead to the discovery of a number of mineral deposits of which some at least would be of importance.

In all countries, early in the process of industrialisation only the richest deposits exposed at the surface were worked and utilised locally or exported. Much wastage occurred at this stage. This was soon followed by industrial development marked by the setting up of metallurgical, chemical and engineering works. The national wealth and prosperity of a country increased during this stage. The third stage is a period of depletion of cheap domestic mineral resources and import of raw materials from outside for feeding local industries. Thereafter comes the stage of having to depend on foreign ore and other raw materials, leading gradually to the loss of competitive power in foreign markets, due to the necessity for purchase of much of the raw material requirements from outside.

India is just passing through the first stage and entering the second. The further stages could be strengthened by careful husbanding of the resources by the adoption of conservation measures. An outstanding example in India, requiring the enforcement of conservation, to which repeated attention has been called, is the misuse of good coking coal for burning in boilers and locomotives for steam raising, for which non-coking coal of a similar grade would do quite well. It is only during the last four or five years that serious steps have been taken to prevent the objectionable use of coking coal.

Conservation has to be effected at all stages of the development of the mineral deposits, in mining, milling and ultimate utilisation. All technological advances in any of these stages automatically bring in improvements which are conducive to conservation. Conservation is also achieved by substituting a more easily available and cheaper material for one which is costly or difficult to get. Substitution is often dictated by necessity, and will be acceptable so long as the easily available substitute is good enough for the purpose for which it is intended. Thus, though it may be worth while using a good grade of mica for all types of electrical insulation, a poorer insulator would serve for some purposes. Mica substitutes are, therefore, coming into use in the countries which have to import this mineral in large quantities.

It is an interesting fact that no mineral has become entirely obsolete and unusable. The pattern of use may change occasionally, but as long as a mineral finds some use, it continues to be employed until it is replaced by something more suitable or is used for some other special purpose. A good example is afforded by monazite for which the black sands of the Travancore coast were originally worked. It was then employed for the requirements of the gas mantle industry. But, after the First World War, the demand for the mineral fell and practically stopped, as gas had largely been replaced by electricity for lighting in Europe. In the meanwhile, ilmenite which is associated with the monazite, found use in the manufacture of a paint pigment—titanium white. This mineral rapidly assumed importance and monazite was nearly forgotten for a while. But during and after the Second World War, monazite has again attained prominence as a possible source of atomic energy because of its content of appreciable amounts of thorium and a little uranium. Ilmenite also continues to be utilised, so that at present there is a good demand for both these minerals.

The latest prophecy seems to be that atomic energy is going to make coal an unwanted material and that coal mining will be a thing of the past within a decade. But we may well ask whether all the uranium needed for bringing about such a complete revolution in the industrial set-up and power production will be available (as also other materials needed for regulation and control of the nuclear reactions) at a price which will compete seriously with coal. Similar prophecies were made about coal when large developments in the production of petroleum as well as of hydro-electricity took place three or four decades ago. There are as yet no signs of coal becoming unnecessary to mine.

Our present knowledge goes to show that we have only a few surpluses and quite considerable deficiencies in the list of useful mine-

rals needed for industry. There is a sufficiency of surplus in coal, ores of iron, manganese, aluminium, titanium, chromium, magnesium; mica, barytes, kyanite, sillimanite and various types of clays. The chief deficiencies are in copper, lead, zinc, silver, nickel, cobalt, molybdenum, tungsten, tin, antimony and mercury amongst the metals; and sulphur, phosphates, fluorspar, petroleum, potash, graphite, asbestos, amongst the non-metallic minerals. In almost every case our knowledge is confined to surface observations. We do not know enough about what lies below the surface even at shallow depths. There is, consequently, a chance of making good some of the deficiencies by extensive and intensive search in suitable areas.

Only during the last few years has the Geological Survey been strengthened suitably in personnel and equipment to face this task adequately. A Bureau of Mines has been established to look after the work of improving the techniques and standard of mining and enforcing mineral conservation measures. An Oil and Natural Gas Division is being set up to undertake systematic and intensive exploration for petroleum. Within the Geological Survey itself there are specialist wings to study Mineral Deposits, Groundwater and Engineering Geology and to conduct Geophysical Exploration. The co-ordinated efforts of all these will be directed towards the study of all the phases of exploration and development of our resources in minerals, and will contribute steadily to the building up of a strong and prosperous nation.

FIRST CONGRESS ON THEORETICAL AND APPLIED MECHANICS

THE First Congress on Theoretical and Applied Mechanics was held on the 1st and 2nd November 1955, at the Indian Institute of Technology, Kharagpur, under the Presidentship of Dr. K. S. Krishnan, Director, National Physical Laboratory, New Delhi. Of the 147 delegates who registered themselves as members, 101 participated in the deliberations of the Congress. Fifty-two papers were read and were followed by lively discussion. Messages of goodwill were received from a number of distinguished workers all over the world.

Dr. S. R. Sen Gupta, Chairman of the Organizing Committee, stressed the need for both theoretical and experimental approaches to any problem of mechanics and advocated a harmonious blending of the two. This was followed by the Presidential Address on 'The Physics of Heated Filaments is Vacuum'. The theory developed by Dr. Krishnan knits into a single whole the uncorrelated empirical results obtained by various experimenters.

There was a half-hour address by Prof. N. Weiner on 'Some Formulæ in Meteorological Prediction'. He showed how with the help of a lemma formulated by him and Kolmogoroff, formulæ for multiple prediction may be developed making use of phase averages or time averages. Other addresses were by L. E. Payne 'On a Class of Problems in Plane Elasticity' and by V. M. Ghatage on 'Ring Aerofoils and Their Possible Use'. Dr. Payne showed how in the problem of semi-infinite elastic medium or of an infinite strip the use of dual integral equations may be avoided by a suitable decomposition of Airy's stress function. Dr. Ghatage indicated an interesting arrangement of a ring aerofoil and a source which could climb in the vertical direction without any horizontal race on the ground, and could also move backward or forward. Though a practical design of this type had not been worked out, it was quite feasible and deserved thought and consideration. A majority of the papers presented at the Congress dealt with problems on elasticity and plasticity. Among the other topics discussed were fluid mechanics, callistics, vibrations, thermodynamics, statistics and mathematical physics.

An *ad hoc* meeting was held for the formation of the Indian Society of Theoretical and Applied Mechanics. The following office-bearers were elected: Dr. K. S. Krishnan (*President*), Dr. V. M. Ghatage and Prof. N. R. Sen (*Vice-Presidents*), Prof. B. R. Seth (*Secretary-Treasurer*).

The First Congress on Theoretical and Applied Mechanics has served a useful purpose in bringing together workers in engineering science from all parts of India, and emphasising the need for producing engineer-scientists along with the establishment of colleges for producing working engineers. It may be essential for this purpose to enrol brilliant graduates from Indian Universities with high academic distinctions in basic sciences like applied mathematics, physics, chemistry, geology, geophysics and statistics, and engage them in research work in theoretical and applied mechanics and other basic subjects on which the science of engineering is built up.

EQUILIBRIUM CONFIGURATIONS OF OBLATE FLUID SPHEROIDS UNDER THE INFLUENCE OF MAGNETIC FIELD

S. P. TALWAR

Dept. of Physics, University of Delhi, Delhi

RECENTLY G. Gjellestad[1] discussed the equilibrium configurations of gravitating incompressible fluid spheroids (homogeneous, inviscid and infinitely conducting) subject to a uniform magnetic field H inside and a dipole field outside. However, in her paper the sign of the integral in the first part of the equation (65) is incorrect. We give, in this note, the results of a more general study of the problem of the equilibrium of *oblate fluid spheroids* in the presence of a magnetic field which is assumed to be described by

(*i*) a uniform field H inside the spheroid in the *z*-direction, and

(*ii*) an external field made up of a uniform field kH along the *z*-direction and that due to a dipole of moment $(1-k)\,\dfrac{H\,(1+E^2)^{\frac{1}{2}}}{Q_1^1\,(iE)}$ (the axis of the dipole being parallel to the *z*-direction) in order to make the normal component of the field continuous on the surface of the spheroid. Here E gives the boundary of the spheroid and the function $Q_1^1\,(iE)$ is defined as

$$Q_1^1\,(iE) = (1+E^2)^{\frac{1}{2}}\,\frac{dQ_1\,(iE)}{dE}$$

$Q_1(iE)$ being the Legendre function of the second kind.

If we take $k=0$, we get a spheroid with a uniform magnetic field inside and a dipole field outside. This case is the same as that discussed by G. Gjellestad. But due to the inconsistency mentioned above, our subsequent results for the case $k=0$ are different. The case $k=1$ corresponds to a uniform field of the same value both inside and outside the spheroid. If we let $k\to\infty$, $H\to 0$ but $kH=H_0$ remaining finite, it corresponds to an oblate spheroid under only an external field made up of a uniform field H in the *z*-direction superposed by a field due to a dipole of moment $\dfrac{H_0\,(1+E^2)^{\frac{1}{2}}}{Q_1^1\,(iE)}$ in the antiparallel direction.

Under the influence of magnetic field of the characteristics mentioned above, we find that there exists a sequence of gravitating oblate fluid spheroids.

The spheroids are assumed to be infinitely conducting, incompressible non-rotating and situated in infinite empty space. Following G. Gjellestad we have used oblate spheroidal co-ordinates which are defined in terms of the triple infinity of orthogonal surfaces provided by the confocal spheroids

$$\frac{x^2+y^2}{1+\xi^2}+\frac{z^2}{\xi^2}=c^2 \qquad (0\leq\xi\leq\infty) \qquad (1)$$

the confocal hyperboloids

$$\frac{x^2+y^2}{1-\mu^2}-\frac{z^2}{\mu^2}=c^2 \qquad (-1\leq\mu\leq+1) \qquad (2)$$

and the planes $\phi=$ constant $(0\leq\phi\leq 2\pi)$ (3) through the Z-axis. Here *c* is a constant equal to half the distance between the foci.

We investigate the stability of an oblate spheroid of boundary given by

$$\xi=E \qquad (4)$$

by subjecting it to a general P_n deformation so that its boundary changes to one given by

$$\xi=E+\epsilon\,\frac{1+E^2}{E^2+\mu^2}\,P_n(\mu) \qquad (n>0) \qquad (5)$$

where ϵ is a non-dimensional constant.

Because of the deformation (5), there shall be a change $\Delta\Omega$ in the gravitational potential energy of the spheroid and a change Δm in the total magnetic energy, which consists of two parts—the change, $\Delta m^{(i)}$ in the magnetic energy inside the spheroid and the change $\Delta m^{(e)}$ in the external magnetic energy. We then employ the equilibrium condition

$$\Delta\Omega+\Delta m=0 \qquad (6)$$

in order to define the equilibrium spheroids.

We find that the total change, Δm, in the magnetic energy vanishes for odd values of *n*, whereas it is of the order ϵ for all even (P_{2n}) deformations, and is given by

$$\Delta m_{2n}=-\frac{H^2C^3(1+E^2)}{Q_1^1\,(iE)}\sum_{n=1}^{\infty}\left\{\frac{\left(1-\frac{k}{3}\right)}{P_{2n}^1(iE)}-\frac{(1-k)\left(1+\frac{k}{3}\right)}{4\,[Q_1^1\,(iE)]}\int_{-1}^{+1}\frac{P_{2n}(\mu)}{E^2+\mu^2}\,d\mu\right\}\epsilon_{2n} \qquad (7)$$

where $P_{2n}^1\,(iE)$ are defined as

$$P_{2n}^1\,(iE)=(1+E^2)^{\frac{1}{2}}\,\frac{dP_{2n}\,(iE)}{dE} \qquad (8)$$

The functions $P_{2n}\,(iE)$ denote the Legendre functions of the first kind.

The expression for the change, $\Delta\Omega$ in the gravitational potential energy of a spheroid as derived by G. Gjellestad, is

$$\Delta\Omega = -\frac{3}{10}\frac{M^2G}{c}\epsilon_2\left[\frac{3E^2+1}{E}\cot^{-1}E - 3\right] \quad (9)$$

where M denotes the mass of the spheroid. The change in the gravitational potential energy of the spheroid is of the first order in ϵ only for a P_2 deformation and of higher order for all higher order deformations.

For a P_2 deformation of the spheroid, for which both Δm and $\Delta\Omega$ are of the order ϵ, the condition

$$\Delta\Omega + \Delta m = 0$$

for equilibrium gives that a configuration is stable for P_2 deformation if

$$H = H_{eq.}\left[\frac{f(e)}{e^2F_2(e)}\right]^{\frac{1}{2}} \quad (10)$$

where, for convenience, we have put

$$H_{eq.} = \sqrt{\frac{3}{10}}\frac{M\sqrt{G}}{a^2}$$

a, being the major half-axis of the spheroid, and G the constant of gravitation.

Here the functions $f(e)$ and $F_2(e)$ are defined as

$$f(e) = \frac{3-2e^2}{e(1-e^2)^{\frac{1}{2}}}\cot^{-1}\left(\frac{1-e^2}{e^2}\right)^{\frac{1}{2}} - 3 \quad (11)$$

and

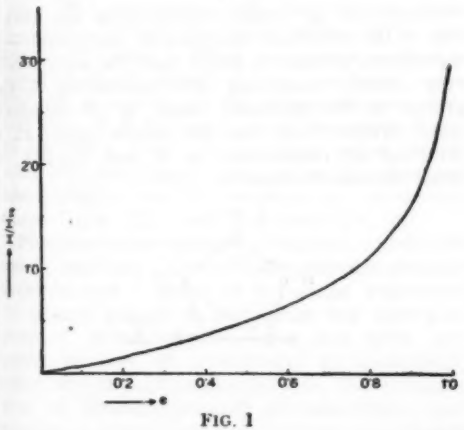

FIG. 1

$$F_2(e) = \frac{e^2\left(1-\frac{k}{3}\right)}{3(1-e^2)^{\frac{1}{2}}Q_1'(iE)} - \frac{(1-k)\left(1+\frac{k}{3}\right)}{4[Q_1'(iE)]^2}f(e) \quad (12)$$

(e denotes the eccentricity of the spheroid).

The function $H/H_{eq.}$ is plotted against e for the case $k = 0$ in Fig. 1, and for the other two cases in Fig. 2. We find that $H/H_{eq.}$ increases with increase in the eccentricity for the three types of magnetic field discussed.

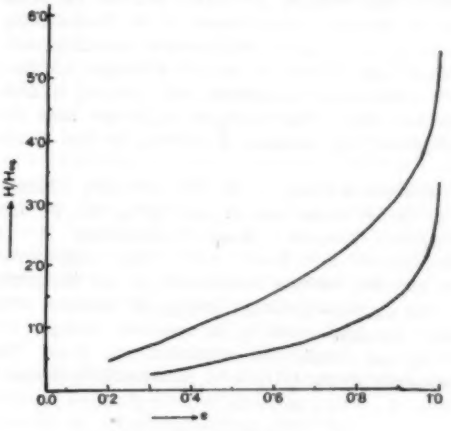

FIG. 2

However, $H/H_{eq.}$ required for stability of the spheroid is more for the case when $k \to \infty$, $H \to 0$ but kH remaining finite ($= H_0$). Thus we find that there exists a unique configuration for a spheroid which is stable for a P_2 deformation for each of the three types of magnetic field under consideration.

The detailed paper shall be published elsewhere.

The author is highly indebted to Prof. D. S. Kothari and to Prof. F. C. Auluck for helpful discussion and constant encouragement.

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LADY TATA SCIENTIFIC RESEARCH SCHOLARSHIPS, 1956-57

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1956-57 commencing from 1st July 1956. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1956. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

THE CHEMISTRY OF FERROCENE AND RELATED COMPOUNDS

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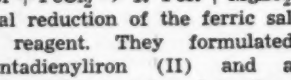
Dept. of Organic Chemistry, University of Madras

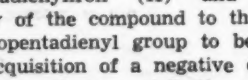
AS a possible route to fulvalene (I), Kealy and Pauson[1] studied the reaction between cyclopentadienylmagnesium bromide and anhydrous ferric chloride but obtained an orange crystalline compound which melted at 173-74° and which analysed for $C_{10}H_{10}Fe$. This compound was soluble in many organic solvents and in addition, was found to be remarkably stable towards acids and bases in striking contrast to the failure of earlier attempts to prepare compounds containing only carbon, hydrogen and iron. The authors suggested that the compound was formed according to the equation

$$2\,R\,MgBr + FeCl_2 \rightarrow R\;FeR + MgBr_2 + MgCl_2$$

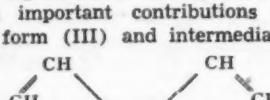
after initial reduction of the ferric salt by the Grignard reagent. They formulated it as biscyclopentadienyliron (II) and attributed the stability of the compound to the tendency of the cyclopentadienyl group to become aromatic by acquisition of a negative charge, resulting in important contributions from the resonance form (III) and intermediate forms:



I



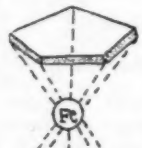
II



III

The isolation of the same compound was reported almost simultaneously by Miller *et al.*[2] who obtained it by reaction of cyclopentadiene at 300° with reduced iron. Biscyclopentadienyliron has since been prepared in excellent yield by reacting the pyridine complex of ferrous acetylacetonate with cyclopentadienyl magnesium bromide.[3]

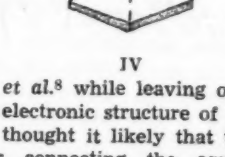
Woodward and co-workers[4] found that the compound was diamagnetic ($\chi^{25°} = -125 \times 10^{-6}$ C.G.S.U.) and that its infra-red spectrum contained in the 3-4 μ region a single sharp band at 3·25 μ indicative of the presence of C-H bonds of one type only in the molecule. The ultra-violet spectrum showed maxima at 326 mμ and 440 mμ and the dipole moment was almost zero. The compound was easily oxidised to a blue cation $[Fe(C_5H_5)_2]^+$ which was isolated in the form of its double salts. In the light of these properties, Woodward *et al.*[4] preferred structure IV according to which two cyclopentadienyl units are bound covalently and symmetrically to ferrous iron. This structure has since been confirmed by X-ray structural studies.[5-7]



IV

Woodward *et al.*[8] while leaving open the question of the electronic structure of biscyclopentadienyliron, thought it likely that the equivalent ring bonds connecting the equivalent C-E groups in the molecule might be of effective order greater than one and might result in a situation as represented in V and similar to what obtains in benzene (VI).

V



VI

This consideration led them to conclude that biscyclopentadienyliron might behave as an aromatic substance and to study some of its reactions which, indeed, established the aromatic nature of the compound which in consequence was named ferrocene.

Ferrocene does not have any properties typical of unsaturated compounds in spite of its formal unsaturation. It does not undergo a Diels-Alder reaction with maleic anhydride and cannot be hydrogenated. With acetyl chloride, in presence of aluminium chloride, it yields a red diacetyl derivative which gives a dioxime and which can be oxidised to a dicarboxylic acid; with β-chloropropionyl chloride and phthalic anhydride, the reaction is similar. With acetic anhydride in anhydrous hydrogen fluoride, monoacetylferrocene[9] is obtained. Ferrocene undergoes sulphonation and also condensation with aliphatic and aromatic aldehydes.[9] Strongly oxidising species such as NO_2^+, Br^+ effect oxidation to the cation, called ferricinium ion, instead of substitution. The infra-red carbonyl absorption maxima for some ketonic derivatives of ferrocene are almost the same as in the corresponding derivatives of benzene. The first dissociation constant of ferrocene dicarboxylic acid (pK_1 $3{\cdot}1 \times 10^{-7}$) is nearly the same as the dissociation constant of benzoic acid (pK $2{\cdot}4 \times 10^{-7}$).

From the vapour pressures and vapour densities, the normal boiling point (249°), molecular weight (186), heats of sublimation (16·8 k. cal./mole) and vaporisation (11·3 k. cal./mole) and the triple point (183°) have been calculated.[10] From the measured heat of combustion of ferrocene, the combined energies of resonance of the five-membered rings and that of C-Fe bonds have been calculated[11] to be 113 k. cals. Such a high value accords with the stability of the compound. Accurate bond lengths are not available but the indications[5-7] are C-C 1·4 A and Fe-C 2·0 A.

Phenylcyclopentadienyl Grignard compounds react similarly to cyclopentadienylmagnesium bromide and a series of ferrocenes substituted by phenyl groups in both rings has been prepared.[12] Monophenylferrocene has been prepared by use of a mixture[5] of cyclopentadiene and phenylcyclopentadiene. The preparation of dibenzoferrocene (bisindenyliron) and bisindenyl cobalt salts has also been described.[13] The preparation of 1, 1'-dibenzhydrylferrocene[12] directly from benzhydrylcyclopentadiene and also starting from diacetyl ferrocene has provided proof that both rings are substituted in the diacetylation of ferrocene. Ferrocene[14] and also ferricinium[15] salts undergo direct arylation when treated with diazonium salts. Both mono- and polyarylated ferrocenes are formed.

The formation of compounds analogous to ferrocene seems to be a general property of transitional elements which have two vacant or singly occupied d orbitals that can be used in bonding. These compounds are of the type $[(C_5H_5)_2Mn]X_{n-2}$ where n represents the oxidation state of the metal M and X is a uninegative ion. Derivatives of Sc[16a], Ti[21,16b] V[21,16b,25], Cr[17], Mn[18], Co[3,9,20], Ni[3,21,12], Y[16a], Zr[21,16b], Nb[16b], Ru[23], Rh[24], La[16a], Ce[16b], Ta[16b], and Ir[24] have so far been reported. Two cyclopentadienyl compounds of Mn exist of which one seems to have a sandwich type structure like ferrocene and the other a metal alkyl structure like diethyl zinc. A magnesium derivative[18] of cyclopentadiene is also known and behaves as a metal alkyl.

These compounds are in general prepared either by reacting a metal halide or a metal acetylacetonate with cyclopentadiene magnesium bromide or by the vapour phase reaction of cyclopentadiene with a metal carbonyl. An elegant variation of the former procedure involves the reaction[20] in liquid ammonia between an alkali metal salt of cyclopentadiene and the appropriate metal amine salt followed by removal of ammonia *in vacuo*, *e.g.*,

$$[Ni(NH_3)_6](SCN)_2 + 2\,C_5H_5K \rightarrow [Ni(NH_3)_6](C_5H_5)_2 \rightarrow Ni(C_5H_5)_2$$

Another variation[18] of the same method is to react sodium cyclopentadiene with a metal halide in tetrahydrofurane medium.

The similarity of the structures of $Co(C_5H_5)_2$ and $Ni(C_5H_5)_2$ to that of ferrocene has been confirmed[20] by X-ray diffraction studies. The infra-red and ultra-violet absorption spectra of the Ru[23] and Ni[3] compounds are similar to those of ferrocene. The magnetic susceptibilities of the Co and Ni compounds have been measured.[3] Many of these compounds are easily oxidised to the corresponding unipositive cations, *e.g.*, $Ni(C_5H_5)_2$ to $[Ni(C_5H_5)_2]^+$. The polarographic behaviour[26] of ferrocene and other biscyclopentadienyl compounds has been studied. The mass spectra[27] of a series of neutral biscyclopentadienyl compounds have been investigated recently with a view to correlate the spectra with molecular structure. Recently, the first representative of a biscyclopentadienyl metal carbonyl has been reported.[28]

As regards the electronic structure of ferrocene, a simple ten-bonded structure is excluded since only 18 electrons are available, 5 from each of the two cyclopentadienyl units and 8 from the iron atom. In proposing the structure IV for ferrocene, Woodward *et al.*[4] suggested that the iron atom could attain the configuration of the inert gas krypton by

utilising these 18 electrons. The filling of vacant metal orbitals in this manner is now regarded unlikely in view of the aromatic character of ferrocene which indicates that the π electrons are not appreciably withdrawn from the rings. Furthermore, the formation of cyclopentadienyl derivatives of transitional elements like Ti, Zr, V, etc., where sufficient electrons are not available for completion of the configuration of krypton, cannot be explained on the basis of such a view. The type of bonding involved in ferrocene and other biscyclopentadienyl compounds has been interpreted by molecular orbital methods by Jaffé,[29] Dunitz and Orgel[6,31] and Moffitt.[30] According to Moffitt, the structures of these compounds involve a primary two electron bond between each ring and the metal atom and a mixing and splitting of the $3d^2_z$ and $4s$ orbitals of the metal atom under the influence of the field of the π electrons of the cyclopentadienyl rings. In the compounds there are four d orbitals of the metal atom at approximately the same energy as the unperturbed d orbitals, two of which are used for metal to ring bonding and two ds hybrid orbitals, one below these four d orbitals and one above at about the level of the $4p$ orbitals. The magnetic properties of many of the biscyclopentadienyl compounds have been explained in terms of such structures.

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INDIAN SCIENCE CONGRESS, 1957

PROF. M. S. THACKER, Director, Council of Scientific and Industrial Research, has been elected General President of the Indian Science Congress for the year 1958.

Dr. B. C. Roy, Chief Minister, West Bengal, is General President for the 1957 session and the following are the Presidents of the different sessions: Prof. K. Chandrasekaran (Bombay—Mathematics); Dr. P. K. Bose (Calcutta—Statistics); Prof. K. R. Dixit (Ahmedabad—Physics); Dr. B. C. Roy (Calcutta—Geology and Geography); Prof. S. N. Das Gupta (Lucknow—Zoology and Entomology); Dr. M. N. Srinivas (Baroda—Anthropology and Archæology); Dr. C. R. Das Gupta (Calcutta—Medical and Veterinary Sciences); Dr. E. S. Narayanan (New Delhi—Agricultural Sciences); Dr. Inderjit Singh (Agra—Physiology); Dr. S. M. Mohsin (Patna—Psychology and Educational Sciences); Prof. G. P. Chatterji (Howra—Engineering and Metallurgy).

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A NEW METHOD OF MEASURING ULTRASONIC VELOCITY IN SOLIDS

According to Raman-Nath[1] theory of diffraction of light by ultrasonic waves in liquids, when a plane wavefront of light traverses in succession two ultrasonic fields of the same frequency, the diffraction pattern will have zero or minimum intensity when there is a phase difference π between the two ultrasonic fields. This principle is applied to find the ultrasonic velocity in solids.

A rectangular glass cell (Fig. 1) containing a liquid is traversed by an ultrasonic wave of frequency N produced by a quartz oscillator Q. In one half (A) of the cell is placed the solid in the form of a wedge C. Another similar wedge D of the solid is placed with the sloping

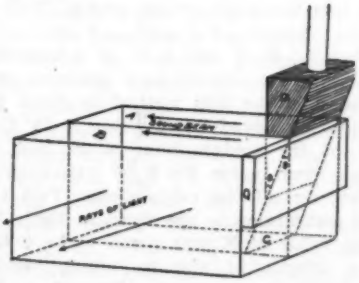

FIG. 1

edge parallel to that of the wedge C and can be moved up or down vertically by a fine calibrated micrometer screw. The two wedges

together form a rectangular slab of thickness d. In compartment A of the glass cell, the ultrasonic waves traverse first a thickness d of the solid with velocity V_2 and thereafter the liquid with velocity V_1, while in compartment B the path of the waves lies entirely in the liquid. The phase difference between these two sets of waves will be π, if

$$d = V_2 (2n+1) \frac{\lambda}{2} \Big/ (V_2 - V_1),$$

where $\lambda = V_1/N$, and n is zero or an integer. Without the solid in A, the two waves will be in the same phase, and a parallel beam of monochromatic light from a narrow slit traversing the cell at right angles to the sound beam will exhibit a diffraction pattern, when viewed by a telescope. On introducing the solid (Fig. 2) the diffraction pattern will disappear when the phase difference between the two waves is an odd multiple of π.

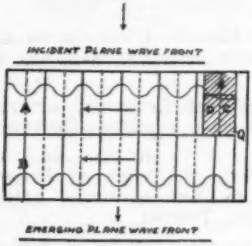

FIG. 2. The sine curves represent the sound waves in the two compartments.

The experiment consists in placing the glass cell on the prism table of a spectrometer and viewing the diffraction pattern through the telescope. The thickness d of the slab of solid traversed by the ultrasonic waves is varied by raising or lowering the wedge D very slowly, while observing the diffraction pattern. If X is the distance through which the wedge is raised between two successive minima $d = X \tan \theta$, where θ is the angle of the wedge. This gives

$$X \tan \theta = V_1 V_2 / (V_2 - V_1) N.$$

Knowing V_1, N, X and θ, V_2 is calculated.

The ultrasonic velocity in a specimen of ebonite measured by this method is given below, the liquid employed being water at 28° C. The angles of the wedges were 9° 26′ and 9° 33′, and the mean value $\theta = 9° 30'$ ($\tan \theta = 0{\cdot}1673$) was used in all the calculations. Two typical sets of measurements are given in Table I. The average value of X was found to be 0·425 cm. with a sample of ebonite, which yielded a value 2086 m/sec. for the ultrasonic velocity. The frequency used was 7·5 Mc/s. and $V_1 =$ 1,500 m/sec.

TABLE I

	Positions corresponding to minima of intensity of Diffraction Pattern			X in cm.	
	Moving up cm.	Moving down cm.	Mean cm.		
1)	4·520	4·561	4·540		
	4·122	4·128	4·125	0·415	0·429
	3·681	3·681	3·681	0·444	
2)	4·513	4·511	4·512		
	4·121	4·121	4·121	0·391	0·417
	3·677	3·677	3·677	0·444	

GOPALA MENON, SREEKANTATH.
University College,
Travancore University,
Trivandrum, *November* 19, 1955.

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AMPEROMETRIC ESTIMATION OF GERMANIUM

AN accurate method of estimation of germanium by the amperometric technique has been developed. The method is based on the precipitation of divalent germanium as a complex with tannic acid, in an acid medium containing ammonium sulphate. The titration is carried out at $-0{\cdot}6$ V *vs.* SCE in presence of a little cresol red functioning as maxima suppressor. Temperature is without effect on the precipitation and on the titre values.

The value of the constant potential required for the amperometric titration was fixed after a study of the polarograms of divalent germanium. The half-wave potential obtained in an acid range of 0·25 to 0·35 N HCl and in presence of $(NH_4)_2SO_4$ (0·8 to 1·0 M) was $-0{\cdot}49$ V *vs.* SCE, working with a concentration of 4 millimoles/litre germanium. A constant potential of $-0{\cdot}6$ V *vs.* SCE which is well within the diffusion current plateau, was chosen for the amperometric titration.

The germanium solution used for the titrations was obtained by reducing a solution of 0·2 g. of pure GeO_2 with sodium hypophosphite[1] and making it up to 100 ml. with HCl to give a final strength of 0·5 N. To known volumes (1–5 ml.) of a 6% tannic acid solution, a few drops of cresol red solution were added with a suitable volume of the solution of the supporting electrolyte [obtained by mixing equal volumes of 0·5 N HCl and 2 M $(NH_4)_2SO_4$] to give a total

volume of 25 ml. The standard germanous solution was added in 0·5 ml. increments. The diffusion current in microamps was read off from the charts obtained on a Tinsley model recording polarograph, the readings being taken 2 minutes after each addition of the germanous solution at a constant potential of −0·6 V *vs.* SCE. The volumes of the germanous solution plotted against the current yielded straight lines, the intersection of which gives the end-point (Fig. 1).

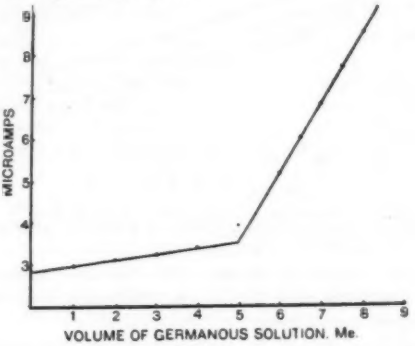

FIG. 1

TABLE I

Tannic acid ml. taken	Germanous solution titre value (from graph) ml.	Deviation ml.
1·00	1·67	0·005
2·00	3·35	0·00
3·00	5·02	0·005
3·50	5·85	0·012
4·00	6·70	0·000
5·00	8·40	0·025

The high accuracy of the method is evident from the data given in Table I, which contains the results of six different experiments. The maximum error is only of the order of 0·3%. It has also been found that arsenic does not interfere in this titration and that temperature is without effect on the precipitation of the complex and therefore on the titre value. It must however be mentioned that if the process of titration is reversed by adding tannic acid to germanous solution, reproducible results are not obtained.

Chemical Tech. Labs., A. C. College of Technology, Madras-25, *November*, 1955.

A. P. MADHAVAN NAIR.
S. HAMSATH IBRAHIM.

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INFLUENCE OF LIGHT INTENSITY ON THE CHARACTERISTICS OF NON-SELF-MAINTAINED REGION OF A LOW FREQUENCY ELECTRIC DISCHARGE

IT has been reported earlier[1-3] that in a narrow potential region below the breakdown potential V_m, i.e., in the so-called non-self-maintained region, of a low frequency electric discharge in an electronegative gas or vapour enclosed in glass vessels, external radiation even in the visible range initiates the discharge; this is accompanied by the observation of certain current pulses on the oscillograph[1] and appreciable current flowing through the system. These exist so long as the external radiation is in operation. The variation with external light intensity of the rms value of the current i in the non-self-maintained region appeared contrary to general theoretical considerations (*vide* infra). The present communication reports a few interesting results on this aspect, which may be helpful for developing a mechanism for the abnormal behaviour of low frequency discharge with reference to external light intensity.

Cylindrical discharge tubes made out of soft soda glass and fitted with external sleeve electrodes were employed; these were similar to those used first by Wiedemann and Ebert.[4] They were filled with pure iodine vapour at a desired pressure and excited by 50 cycle potentials in the range 0·5-2 K.V. The rms value of the current flowing through the system was measured by a sensitive microammeter or a galvanometer suitably coupled with a crystal-rectifier 1 N 34. The details of the experimental technique have been given elsewhere.[1] Monochromatic radiations, $\lambda = 4047$, 4358 and 4916 Å, were obtained from a mercury arc lamp employed in conjunction with suitable Wratten filters; the radiations were used at different intensity values (1-400 in arbitrary units).

Fig. 1 gives a typical series of results on the variation with potential of the current initiated by $\lambda = 4047$ Å at different intensities ($I = 65$ and 365). In the absence of the external light in the potential region from 95 to 200 volts/cm. the discharge was negligible; and the current passing through the system was inappreciable (curve 1, Fig. 1). When the discharge tube was illuminated, say, by $\lambda = 4047$ Å, appreciable current was recorded (curves 2 and 3, Fig. 1). This was observed, as mentioned above, as long as the radiation was on and disappeared when this was cut off, indicating the characteristic features of a non-self-maintained region (*a-b*, Fig. 1) of the

discharge under investigation. Further, it was interesting to note from the data in Fig. 1 that with increase in intensity (I) of light from $I = 65$ to 365, the photo-current, curiously enough, decreased in its magnitude (*cf.* curves

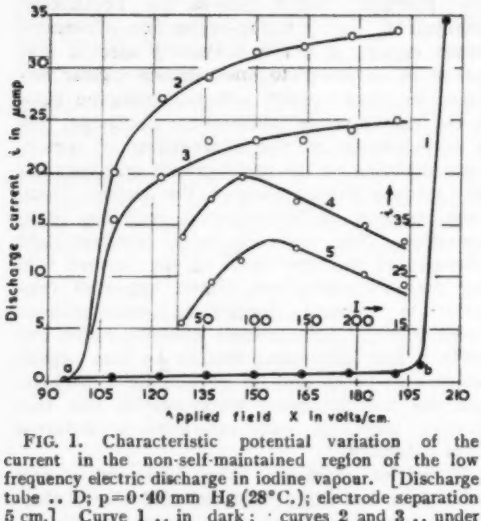

FIG. 1. Characteristic potential variation of the current in the non-self-maintained region of the low frequency electric discharge in iodine vapour. [Discharge tube .. D; p=0·40 mm Hg (28°C.); electrode separation 5 cm.] Curve 1 .. in dark; curves 2 and 3 .. under light ($\lambda = 4047$ Å at relative intensities 65 and 365 respectively).

The inset refers to the variation of current i with light intensity I. Discharge tube .. B; p = 0·45 mm. Hg (30°C.); X = 155 volts (rms)/cm. Curve 4 .. electrode separation d = 5 cm.; curve 5 .. d = 4 cm.

2 and 3, Fig. 1). Contrary to this observation, theoretical considerations on photo- and thermo-electric effects and on electric discharge in gases show that increase in the intensity or the number of photons of the *sensitive* radiation should enhance the number of *photo*-electrons initiated into the system, which are responsible for the development of the so-called electron avalanches and the conductivity of the gas or vapour under applied fields.[5,6] Further, detailed investigations over a wide range of intensities showed that at a given applied potential, the photo-current i increased initially with rise of light intensity I to a maximum (I_m) and then decreased with further increase in intensity (*see* inset, Fig. 1). It was remarkable that this value of I_m appeared to be a function of the applied field X. Thus the results in Fig. 2 show that log I_m varies linearly with X for different electrode separations d. Furthermore, the plots log I_m *vs.* X at various values of d are parallel to each other and have a negative slope. The results suggest that a relationship such as $I_m = ae^{-bx}$ (where a and b are constants) is applicable to the features in the non-self-maintained region of the low frequency electric discharge in iodine vapour. Fuller details will appear elsewhere.

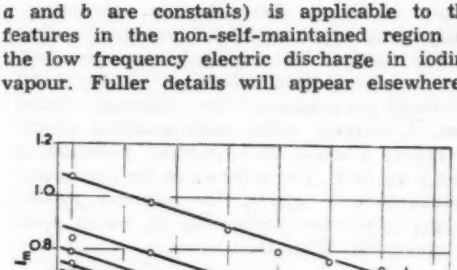

FIG. 2. Variation of log I_m with applied field X at different electrode separations d = 3·5 (1), 3·75 (2), 4·0 (3), 4·25 (4) and 4·5 cm. (5).

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BROKEN BONDS IN KAOLINITE

THE existence or otherwise of 'broken bonds' in kaolinite as the seat of ion exchange is still an open question. Arguments have been put forward both in favour[1,2] and against[3,4] the 'broken bond' concept. The non-entry of anions like chloride, sulphate, nitrate, etc., in kaolinite from aqueous solutions by exchange has been put forward as a strong evidence against this hypothesis since the presence of 'broken bonds' in kaolinite should attribute an amphoteric character to this mineral. This argument does not however seem to be quite conclusive because even if anions are adsorbed at the 'broken bonds', they are liable to subsequent re-exchange for the hydroxyl ions present in

aqueous medium. Conclusive experimental evidence is therefore lacking to decide the issue. To eliminate the uncertainties arising out of this factor, studies have been made in the present work of the adsorption of potassium iodide in acetone in which potassium iodide is known to behave as a strong electrolyte.[5] The use of non-aqueous medium was expected to inhibit the re-exchange of adsorbed anions due to the factor discussed above. A dry sample of hydrogen-kaolinite, having a base exchange capacity of 3·90 milliequivalents (m.e.) per 100 g. of the mineral, was repeatedly leached with a solution of potassium iodide in acetone, the free potassium iodide was then washed off with dry acetone. Finally, the adsorbed cations and anions were displaced by leaching the 'treated' mineral first with water and then with a dilute solution of hydrochloric acid. The water extract was analysed (by conductometric titration against standard silver nitrate solution), for adsorbed iodide and the acid extract for adsorbed potassium following usual procedure. The amounts of iodide and potassium ions adsorbed by hydrogen-kaolinite sample used amounted respectively to 3·85 m.e. and 3·90 m.e. per 100 g. of the mineral. The adsorbed anions and cations are thus each equal to the base exchange capacity of the clay mineral. The amphoteric nature of kaolinite thus established may be taken to prove the presence of 'broken bonds' in kaolinite.

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STRUCTURE PATTERN OF CERTAIN GRANITIC BODIES FROM MYSORE

A DETAILED study of the structural pattern of certain granitic bodies in Mysore has been undertaken to investigate the possibilities of correlating the structure pattern with the method of igneous intrusion. Plutons of smaller dimensions offer themselves typically for such a study. One such pluton is situated S.-E. of Mysore known as Chamundi granite and is about 12 square miles in area, striking generally N.-E. and S.-W. consisting of coarse- to fine-grained pink and grey granites and is subsequently traversed by numerous dykes and veins of pegmatites and aplites. A careful investigation in the field as suggested by Cloos[1] and Balk[2] has revealed the presence of linear elements and fractures indicating a definite pattern.

The phenocrysts of orthoclase feldspar show a definite alignment at the contacts. The basic inclusions are usually long-drawn-out, often tapering at both ends, and their longer axes are generally parallel to one another. Nearly 230 readings were taken all over the pluton and the trend of flow lines suggest a regular pattern as indicated by the generalised direction of the flow lines in the accompanying map (Fig. 1).

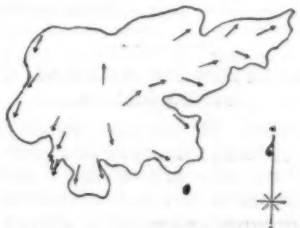

FIG. 1. Structure map of Chamundi Granite showing the linear elements. The arrows indicate the generalised flow-lines. (Scale 1" = 1½ miles.)

The fracture pattern reveals two distinct and well-developed joints, 'Q' joints always occurring at 90° to the flow lines, and 'L' joints always occurring parallel to the flow lines. There are also 'D' joints occurring at 45° to both 'Q' and 'L' joints. Many of these fractures are filled up by pegmatites, aplites and quartz. They have developed so systematically that they form very conspicuous features from a distance.

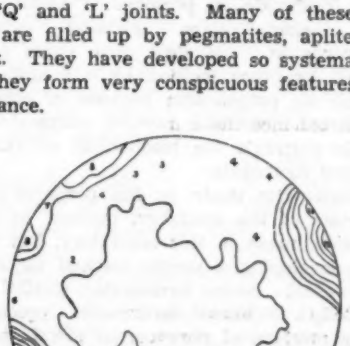

FIG. 2. Orientation diagram for the pitch of 102 fractures in Chamundi Granite. The pattern discloses two prominent systems, one showing a maximum of 7 to 8% pitching generally NW & SE, and the other showing a maximum of 10 to 12 % pitching generally NE & SW.

The direction of pitch of 102 fractures have been plotted in the accompanying orientation diagram as suggested by Billings[3] (Fig. 2) and it is very interesting to note that a definite pattern is indicated. Further, there is a constant relationship between these fractures and the flow elements. Detailed discussion will be published elsewhere.

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PREPARATION OF NORMAL CERIC HYDROXIDE

THE existence of normal ceric hydroxide $Ce(CH)_4$ or $CeO_2.2\,H_2O$ has not been reported except by Carnelly and Walker,[1] who studied the dehydration of wet ceric hydroxide at various temperatures and found a definite hydrate $CeO_2.2\,H_2O$, stable up to 600° C. Hopkins,[2] on the other hand, describes a compound of the formula $2\,CeO_2.3\,H_2O$ obtained by adding ammonium hydroxide to ceric ammonium nitrate solution. According to Wyronbolf and Vernuil[3] the violet layer formed by exposure of cerous hydroxide to air is cero-ceric hydroxide. Spencer[4] observes that oxidation of cerous hydroxide, in presence of alkali carbonates, takes place forming hydrated ceric peroxide. Although ceric oxide can be obtained by other methods,[5,6] it is difficult to establish its composition because of other co-precipitated materials. Several workers[7-9] have tried to elucidate the mechanism of oxidation of cerous hydroxide.

A systematic study of the preparation and properties of the oxidation product of cerous hydroxide, made in this laboratory, has resulted in developing a simple method for obtaining normal ceric hydroxide $Ce(OH)_4$ or $CeO_2.2\,H_2O$. Cerous hydroxide, precipitated from a mixture of pure cerous nitrate solution and ammonium hydroxide, was oxidised with hydrogen peroxide and left overnight. The pale yellow precipitate was filtered off and washed free of soluble impurities, pressed between folds of filter-paper and then washed twice with dioxan by decantation and filtered. Washing with dioxan was continued several times on the filter. It was then washed with pure dry petroleum ether (30-75° C.) and dried in a current of dry-air free from carbon dioxide when a dry, free-flowing yellow powder w obtained. A known weight of the powder w ignited to estimate the water content. The an lytical results showed that the product corre ponded with the formula $Ce(OH)_4$ $CeO_2.2\,H_2O$. Similar results were also obtain when absolute alcohol and dry ether were us as wash liquids.

Details will be published shortly. The auth is thankful to Prof. K. R. Krishnaswami, f his interest in this investigation.

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ISOLATION OF HEXACHLOROCERIC ACID

ATTEMPTS made so far, for the isolation ceric chloride or the corresponding hexachlor ceric acid have not succeeded.[1] The reas for the marked instability of ceric halides ha not been fully understood. Only the fluorid are known as normal salts of both cerous a ceric cerium.[2-4] Ceric chloride has not be isolated in the free state, although the da red solution obtained when ceric hydroxide dissolved in concentrated hydrochloric acid, supposed to contain ceric chloride or hexachlor ceric acid which decomposes rapidly with evo tion of chlorine. Although neither the hex chloroceric acid nor a salt of this has been i lated from the aqueous solution, salts of orga bases have been isolated from non-aque solutions.[5,6] Koppel[5] was the first to rec nise the role of moisture towards the insta lity of the compound and used anhydrous met alcohol for the reaction of dry ceric hydrox and dry hydrogen chloride gas and obtain an orange-coloured solution from which could not isolate the free acid or ceric chlor

The work carried out in this laboratory h shown that it is possible to obtain crystals

hexachloroceric acid with dioxan of crystallisation. Pure, dry, hydrated ceric oxide (10 g.) suspended in anhydrous dioxan (200 c.c.) was treated with dry hydrogen chloride gas for about 3 hours. The liquid quickly turned orange-red in colour and the temperature rose to about 50° C. After filtering off the pale-yellow residue, the solution was kept at 2-3° C. for 24 hours. Needle-shaped orange-red crystals separated out. They were filtered off, washed with a little dioxan and then with petroleum ether and dried in a current of dry air. Care was taken to exclude moisture during the above operations. The crystals on analysis were found to agree with the formula H_2CeCl_6, $4\,C_4H_8O_2$. The pyridinium double salt was prepared from a solution of the crystals in methyl alcohol and was found to agree with the formula $(C_5H_5N_2)H_2CeCl_6$. The details of these studies and results of the studies on the physico-chemical properties of the crystals will be published elsewhere.

The authors are thankful to Prof. K. R. Krishnaswami for his keen interest and helpful discussion during the course of the work.

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EFFECT OF RAUWOLFIA ALKALOIDS ON SOME ENDOCRINE FUNCTIONS

The elucidation of the mechanism of action of Rauwolfia alkaloids has revealed that crude total alkaloids (C.T.A.) possess both central depressant and peripheral adrenolytic action[1,2] and reserpine depresses the sympathetic regulating centres in the hypothalamus.[3,4] Hypothalamus is the basically important central mechanism regulating the trophic hormones from the anterior pituitary for the gonads. A close relationship has been shown to exist between the genital function and autonomic nervous system.[5,6]

Since C.T.A. depress the hypothalamus and cause autonomic imbalance, the influence of this drug on the ovarian function has been studied and compared with that of reserpine which has no adrenolytic activity and has been shown to cause disturbance in normal œstrus cycle of rats.[7]

The effect of these crude alkaloids, prepared as previously described[8] and their mechanism of action has been investigated by the administration of C.T.A., reserpine and serum gonadotropin to normal, ovariectomised and to hormonally induced œstrus rats.

The results of all the above experiments indicate that both C.T.A. and reserpine cause a prolongation of the œstrus cycle, the di-œstrus phase being chiefly involved; C.T.A. has no œstrogenic action, does not interfere with the cornification produced by œstradiol benzoate, exerts a slight irritant action on vaginal epithelium; causes a reduction in weight of the ovaries and uteri and a slight degree of hypertrophy of the adrenals and atrophy of the thymus. The weight loss of the ovary and the prolongation of the œstrus cycle was not observed in rats treated with serum gonadotropin after C.T.A. administration.

These observations suggest that the disturbance in the œstrus cycle is due to a diminished follicular hormone secretion of the ovary as a result of the depressant action of the drug on the hypothalamus mediated through the hypothalamus pituitary-gonad triangle.

The detailed paper will be published elsewhere.

Our thanks are due to the Himalayan Drug Co. (Bombay), Ciba Pharmaceuticals (Basle) and Schering A. G. (Berlin), for the supply of *Rauwolfia serpentina* (Benth), reserpine (Serpasil) and serum gonadotropic hormone (Priantin) respectively.

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MICROSPOROGENESIS IN *FIMBRISTYLIS QUINQUANGULARIS* KUNTH.

THE microspore mother-cells in the anther-lobe undergo two simultaneous reduction divisions. No quadripartition of the mother-cell takes place and thus for a time being four free nuclei are found within the wall of the mother-cell. Out of these nuclei, one remains in the centre and becomes the functional microspore nucleus, the rest being pushed to one end of the mother-cell. The functional nucleus grows larger but the remaining nuclei retain their original size. Later, a distinct septum is formed separating the functional nucleus from the three non-functional nuclei. In *Fimbristylis cericea*,[1] Tanaka did not observe any clear septum formation between the functional nucleus and the three non-functional nuclei as well as septa formation between the latter, whereas our observations here show clear septa between the nuclei as in *Carex*[2] and *Scirpus*[3] observed by Tanka.

Occasionally, the non-functioning nuclei undergo a division but no wall is laid down between the daughter-nuclei. Prior to the division of the functional nucleus, all these nuclei degenerate and their separating walls are also dissolved and ultimately only one functional microspore is formed per mother-cell.

The authors are thankful to Shri U. Mukerjee for facilities.

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A COLORIMETRIC METHOD FOR THE ESTIMATION OF BUTYLATED HYDROXYANISOLE IN FATS

BUTYLATED hydroxyanisole (BHA) is extensively used as an antioxidant in the stabilization of lard and shortening.[1] It is therefore necessary to have a simple and accurate method for the quantitative determination of BHA added to fats and fatty foods. Mahon and Chapman[2,3] have recently published two methods for the estimation of this antioxidant using either αα'-dipyridyl or 2 : 6 dichloroquinonechlorimide as reagents. Both the methods suffer from the disadvantage that the reagents αα'-dipyridyl and 2 : 6 dichloroquinonechlorimide are costly and difficult to procure. In the present communication. a simple and inexpensive method for the determination of BHA in fat is described. The principle of the method is based on the oxidation of the antioxidant by ferric sulphate and the reaction of the resulting ferrous sulphate with ferricyanide and measuring the blue colour of ferrous ferricyanide complex with a colorimeter. Methods based on the above principle have been described by other workers[4–6] for the estimation of tocopherol in oils.

The reagents required were prepared as follows: (*a*) Standard BHA solution (strong 0·1 mg. per c.c.) was prepared by dissolving pure BHA in 72% alcohol, (*b*) Standard BHA solution (dilute, 8 μg. per c.c.) was prepared freshly when required by suitably diluting the strong solution with 72% alcohol, (*c*) Ferric sulphate solution (0·5%) was prepared by dissolving 0·5 g. of ferric sulphate (A.R.) in 100 c.c. of 1-N sulphuric acid, (*d*) potassium ferricyanide solution (0·2%) was prepared by dissolving 0·2 g. of potassium ferricyanide (A.R.) in 100 c.c. of distilled water. All the solutions were preserved in a refrigerator. Alcohol, free from reducing substances, prepared according to the method of Kartha *et al.*,[6] was used in all the experiments.

In preliminary experiments, the optimum quantities of ferric sulphate and potassium ferricyanide solutions required to produce maximum colour with known quantities of standard BHA solution were determined. The procedure finally adopted for the colorimetric determination of BHA was as follows: Aliquots of the standard or unknown extract (containing about 4-30 μg. of BHA) were pipetted out into test-tubes and diluted to a volume of 10 c.c. with 72% alcohol. 0·5 c.c. of potassium ferricyanide solution and 0·5 c.c. of ferric sulphate solution were added and mixed. The colour was allowed to develop in the dark for 15 minutes. The maximum intensity of colour was reached within 15 minutes after which it was found to be stable upto 1 hr. The intensity of the colour was measured in a Klett-Summerson photoelectric colorimeter using a 660 mμ filter. From the results obtained, it was found that a linear relationship existed between increasing quantities of BHA and intensity of blue colour of ferrous ferricyanide complex. It was also observed that the readings, in Klett-Summerson colorimeter for the same concentration of BHA, was greater by the present method than by the αα'-dipyridyl method.[2]

The recovery of BHA added to hydrogenated groundnut oil was also determined. The anti-

oxidant was extracted from the fat dissolved in petroleum ether using 72% alcohol according to the procedure of Mahon and Chapman.[2] BHA present in the extracts was determined by the method outlined above and the values compared with those obtained by αα'-dipyridyl method.[2] The results are given in Table I. The values for the recoveries of BHA, as estimated by the present method, agree well with those determined by dipyridyl method. It may be seen from the table that about 95% of BHA added to hydrogenated groundnut oil could be recovered.

TABLE I

Recovery of the BHA added to hydrogenated groundnut oil

Amount of BHA added to fat (mg.)	Amount of BHA recovered by:	
	Present method (mg.)	αα'-Dipyridyl method (mg.)
0	0	0
10	9·6	9·4
20	18·8	19·0
30	29·4	29·0
40	38·0	39·0

Further studies on the stability of added BHA during the storage of fats are in progress.

Our thanks are due to Dr. V. Subrahmanyan, Director of this Institute, for his keen interest in this investigation.

Central Food Tech. Res. Inst., Mysore, *August* 30, 1955.

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THE EFFECT OF FRONTAL SECTION THROUGH THE HYPOTHALAMUS ON RESPIRATION IN DIENCEPHALIC CATS

IN an earlier communication[1] it was stated that during experiments with a view to prepare diencephalic cats it was noticed that approximately 20% of the animals (13 out of 64) exhibited very hurried and rather shallow respiration. These respiratory changes followed soon after the frontal (coronal) section through the hypothalamus in decorticate cats; also that they were not seen to appear in decerebrate cats. This led to the consideration of the possibility of the frontal section being at a level whereby some polypnœic centres were released from rostral inhibitory control.

In cats bilaterally decorticated under ether, frontal sections were made at different planes: (1) immediately in front, (2) further rostral, and (3) caudal to the optic chiasma. In another group no frontal section was made. 'Sham rage' developed in all the cats, but a very hurried and rather shallow respiration developed within 10-20 minutes only in cats belonging to group (1). In some of these polypnœic animals of group (1) a second frontal section was made in front of the tuber cinerium which was immediately followed by a change in character and slowing in the rate of respiration.

Macroscopic examination of brain specimen, preserved in 10% formol saline, revealed that the frontal section had passed in group (1) within 1 mm. of the optic chiasma, in group (2) at least 6 mm. in front of the chiasma, and in group (3) [also in the second transection in group (1)], immediately in front or even through the tuber cinerium.

The existence of a hypothalamic polypnœic centre has been suggested by Magoun *et al.*[2] and Houssay,[3] and it has been shown by various workers that certain cortical areas, *viz.*, the posterior part of the orbital surface of the frontal lobes (area 13) and the cingulate gyrus (areas 23 and 24) were concerned with the control of respiration.[4-7] Stimulation of both of these areas have been followed by inhibition of respiration.[3,7-9]

The orbital and the cingulate areas have been shown to be connected, sometime directly, with the hypothalamus. Le Gros Clark and Mayer[10] have shown that fibres from the post-orbital cortex (areas 13) and also from area 6 pass down to the hypothalamus and are finally conveyed to their termination by way of the medial forebrain bundle. They have also shown that these cortical areas project fibres either directly or by collaterals to the anterior hypothalamic areas, the dorso-medial hypothalamic nucleus and the periventricular arcuate nucleus. Thus an intimate connection between the hypothalamic nuclei and the cortical area specifically concerned with autonomic respiration is established.

A frontal section passing immediately in front of the optic chiasma as in group (1) of the experiments is most likely to sever all the efferent fibres from the post-orbital cortex,

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including those that cross in the rostrum of the corpus callosum, and also the fibres sent directly or by collaterals to the anterior hypothalamic area; the anterior periventricular region will thus be released from a tonic inhibitory cortical influence, and a panting type of breathing will ensue.

When the section is made further rostrally as in group (2), neither the post-orbital areas nor the efferent fibres from these areas are likely to be severed and therefore no respiratory changes follow the transection.

A frontal section passing through the tuber cinerium as in group (3) and also after the second transection in group (1) removes completely the anterior periventricular region along with the area responsible for polypnœic breathing and evidently therefore no panting type of breathing follows the transection.

In the group of experiments where no frontal section is made, these areas or the fibres therefrom are not affected at all. It shows moreover that the inhibitory control is primarily exerted most probably by the post-orbital cortex.

It is therefore suggested that, normally in intact animals an anterior periventricular hypothalamic tachypnœic (polypnœic) centre might be kept tonically inhibited by rostrally situated centres in the cerebral cortex which exert their inhibitory control through the corticohypothalamic fibres described above. The severance of these fibres removes the cortical control over this hypothetical centre. This may provide some plausible explanation of the present experimental findings.

Provincial Drug Control Laboratory, S. R. DASGUPTA.

School of Tropical Medicine,
Calcutta-12, *September* 13, 1955.

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NEUROSECRETORY CELLS IN *CALOTES VERSICOLOR*

SCHARRER,[1] in his studies of the neurosecretory system of the garter snake *Thamnophis* sp., described the hypothalamic neurosecretory system as being constituted by the nucleus paraventricularis and the nucleus supra-opticus. The cells of these nuclei function as secretory centres which elaborate a stainable material, which passes along the axons and is stored in the neural hypophysis and in the base of the paraphysis. Recently, Ananthanarayanan,[2] working on certain South Indian reptiles, verified Scharrer's observations and went further to describe concentrations of nerve cells with very prominent cytoplasmic content in the midbrain in relation to the iter and also in the medulla oblongata. He suggested that these mesencephalic and medullary cells may have a neurosecretory function.

In the course of a study of the responses of the neurosecretory cells to various types of stress in the garden lizard, genus Calotes, the following facts have been incidentally noted.

The animals were killed either by decapitation or with an overdose of chloroform. Care was taken to minimise, as far as possible, the occurrence of non-specific stress, which, in the mammalian neurosecretory system, has been shown to produce profound changes.[3] The brain and spinal cord were removed and fixed in Bouin's or Helly's fluid or in 10% formol, and sectioned at 6-7 μ thickness. The staining methods employed included Gomori's chrome alum-hæmatoxylin phloxin; Gomori's aldehyde-fuchsin; Matsuura's phosphotungstic acid-Congo-red and thionin for Nissl material. Of these, Gomori's chrome alum-hæmatoxylin phloxin method proved to be the most reliable and useful one.

The supra-optic and paraventricular nuclei consist of large, globular or spindle-shaped neurones which take a remarkably intense stain with Gomori's chrome alum-hæmatoxylin phloxin method. These cells have large spherical nuclei, which may have a central or eccentric situation in the cell (Figs. 1 and 2). The nucleoli, often paired, are large and highly phloxinophilic. The cytoplasm is dense, homogeneous and stains a deep blue to blue-black with Gomori's chrome hæmatoxylin method. The density and homogeneity depends on the structure of the intra-cytoplasmic granules. These granules, in the majority of cells, are extremely fine and powdery, and are uniformly dispersed in the entire cytoplasm. The axons of these neurones have a beaded appearance

and can be traced from the cell body to greater or lesser extents towards their destination. Rarely cells containing two nuclei have been seen. The entire nuclear bed is very richly vascular.

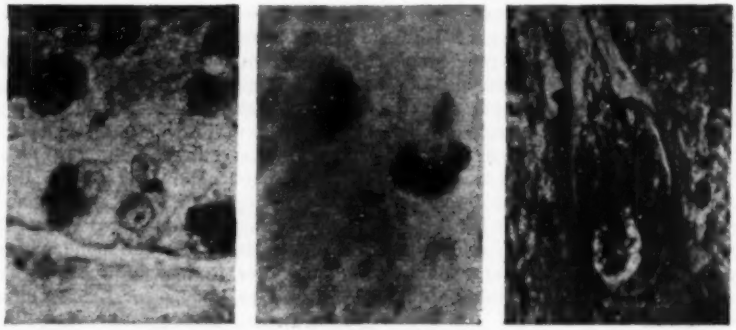

FIG. 1. Photomicrograph of cells of the nucleus supra-opticus of *Calotes versicolor*.
FIG. 2. Photomicrograph of cells of the nucleus para-ventricularis of *Calotes versicolor*.
FIG. 3. A cell from the medulla of *Calotes versicolor*.
The photomicrographs are from sagittal sections of the brain stained with Gomori's chrome alum-hæmatoxylin phloxin method, ×570.

Besides these neurosecretory cells in the hypothalamus, certain other neurones around the aqueduct, in the medulla and in the spinal cord, were also stained fairly deeply by all the methods used. These cells, however, differed from those of the nucleus supra-opticus and nucleus paraventricularis in their morphology and staining reactions. The neurones in the midbrain, medulla and spinal cord (Fig. 3) are generally large, spindle-shaped with medium-sized nuclei and large, coarse, rod-shaped material in the cytoplasm. Depending on the general intensity of staining these granules take a pale bluish violet to grey colour, with Gomori's chrome-hæmatoxylin method. The thionin preparations show that these intracytoplasmic bodies are merely clumps of Nissl material.

One of the most remarkable features of the cell aggregations in the hypothalamus is that not all their constituent cells have a similar appearance. Cells differ from each other in their size, position and staining qualities of the intracellular structures. Indeed, it may be said that no two cells look alike in this region. These differences, together with the abundance or paucity of the stainable cytoplasmic granules are an index of the varying phases of secretory activity of these cells. Such variations between the cells of a given "nucleus" have never been observed in any other part of the brain. Neurones in the medulla, though stained deeply with Gomori's chrome hæmatoxylin method, are distinct from the neurosecretory cells in having medium-sized nuclei, large, coarse, rod-shaped cytoplasmic granules arranged parallel to the cell-surface and an absence of intra-axonal material which is Gomori positive. So the neurones in the midbrain and medulla of the *Calotes versicolor* are different structurally from the neurones of the supra-optic and paraventricular regions, and probably are not neurosecretory in nature.

A detailed study of the neurosecretory mechanisms in *Calotes versicolor* is being carried out in this laboratory.

I am greatly indebted to Prof. V. Sitarama Rao, for his valuable guidance and keen interest.

Dept. of Anatomy, K. R. PANDALAI.
Andhra Medical College,
Visakhapatnam-1, *November* 1, 1955.

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'FRONTOPARIETAL' BONE IN ANURA (AMPHIBIA)

GRIFFITH[1] in his study on the frontoparietal bones in Anura found that in the majority of ranid species examined by him, each half arose from two different centres. The posterior of these (parietal) grew both anteriorly and posteriorly and united with the frontal during its forward growth. The two frontoparietals later met in the midline. In the Discoglossid, Hylid, Pelobatid, Rhacophorid and Pipid

species examined by him, a frontoparietal was seen on either side and each arose from a single centre before it met its companion. In the other families examined by him, there was variance; some species showed a single centre while others exhibited two. He also pointed out in this connection that (p. 786), "In all the species in which the frontoparietal ossifies from a single centre, its pattern of development is similar to that of *Bufo marinus*". Of the Pipidæ, he examined only *Xenopus* tadpoles.

Griffith's above inquiry was prompted by the observation of Eaton[2] who considered the roofing bone in the orbitotemporal region in Anura as a frontal arising as it did from a single centre anteriorly in more than one species of frogs examined by him. Sedra[3] also came to the same conclusion confirming the observations of Eaton by adding to the list two more bufonid and a ranid species.

While examining the development of the chondro- and osteo-cranium of *Hemipipa carvalhoi* Mir.-Rib. (Pipidæ), I noticed that the development of the 'frontoparietal' conformed to neither of the above described methods. In a tadpole measuring 15 mm. (snout to vent, with small stumpy posterior limbs) the 'frontoparietal' has appeared in the form of a somewhat oval *median* ossification (Fig. 1). The bone covers the large fontanel in this region and slightly expands in front of the otic capsules and then gradually narrows between them extending to in front of the vertebral column. I have examined as many duplicates available of the earlier stages as possible of this rare material and the alizarin transparencies of 13 mm. (snout to vent) tadpoles have not brought out the presence of any ossification. In sections also, I have not noticed any tissue answering to bone by staining with Mallory in stages earlier than 15 mm.

In describing the frontoparietal of adult *Xenopus tropicalis*, Griffith[1] noted that the bones were fused in the middle and in another species *lævis*, Paterson[4] also noticed the appearance of frontoparietals as 'paired dorsolateral bones' which fused mesially only in the young frog. From the descriptions of Parker,[5] it could be made out that in *Pipa monstrosa* the frontoparietal arises from two centres, anterior, frontal and posterior parietal, and then the bones fuse in the young frog to form a single roofing bone by uniting in the middle line.

In *Hemipipa* on the other hand, the bone appears as a single median centre and it is very unlikely that the bone arises paired and then unites in the midline between the stages referred to above, for, in its other congeners this fusion takes place only during or after metamorphosis. Further, in *Hemipipa* the bone does not show any feature of having arisen dually. Therefore, this appearance of a large median ossification extending over the orbitotemporal and occipitoauditory regions is really a case of developmental acceleration. In the older stages of *Hemipipa* examined (17 mm. snout to vent, four-limbed), the bone has extended on all sides.

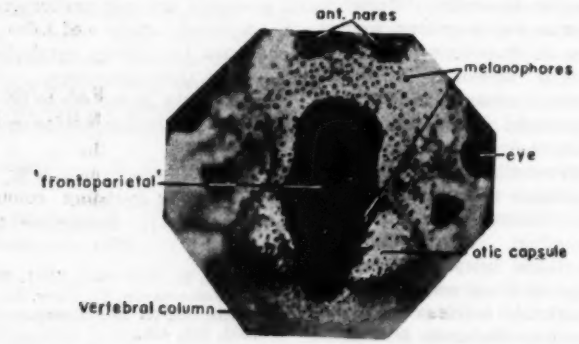

FIG. 1. Photograph of the dorsal view of a 15 mm. (snout to vent) long tadpole of *Hemipipa* showing the median 'frontoparietal', × 5.

In a case like this, it would be exceedingly difficult to say whether the bone represents a frontal or a frontoparietal using the criteria employed by Griffith and Sedra.

I must express my sincere thanks to Mr. Antenor L. de Carvalho, for the gift of *Hemipipa* tadpoles made during our stay at Stanford University, California, and to Sri. M. Veerabhadriah, for taking the photograph. I am

particularly indebted to Prof. B. R. Seshachar, for helpful criticism.

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TRIFIDAPHIS GOSSYPII, SP. NOV. (FAM. APHIDIDAE), A NEW SPECIES OF APHID PEST ON COTTON IN BOMBAY KARNATAK

THE genus *Trifidaphis* appears to be very poorly represented and its description as given by Theobold[1] is considered incomplete in many respects. It may be that so far very few species have been described under it. Theobald mentions only one species—*Trifidaphis phaseoli*, as having variable characters. According to him the genus is demarcated by the long second antennal segment. However, a new species with widely different characters has been recently collected by the author on the roots of cotton at Dharwar, Bombay State. Its description is given below with the object of fixing up the characters of the genus *Trifidaphis* in the first place, and secondly to record the new monotypic species *Trifidaphis gossypii*, sp. nov. collected by the author under the genus *Trifidaphis*. The complete description of the insect is to be published shortly.

Trifidaphis gossypii, SP. NOV.

Alate Viviparous Female.—Average length 2·36 ± 0·02 mm. Head: flat between the antennal bases with small short hairs on the vertex. Eyes: normal, fairly large. Antennal tubercles absent. Distance between bases of antennæ measured 0·22 mm. Rostrum: reaching well beyond second coxæ, chitinised apically with some short stiff hairs. Antennal segments: average length of first 0·064, second 0·096, third 0·256, fourth 0·096, fifth 0·160 and flagellum 0·160 mm. long. Segment three with 12-14 sensoria, segment four with 4-5 sensoria and fifth and sixth segments carry only the primary sensoria. Thorax: dark brown. Legs: mostly uniformly dark grey, average lengths of fore, mid and hind tibia measured 0·56, 0·64 and 0·83 mm. respectively. Fore wings: wing insertions pale yellow, stigma dark, cubitus is unbranched, the two discoidal veins originate from a common point. Hind wings: normal. Abdomen: pale grey with median broad darker patches extending from first to last segment. Cornicles: absent. Cauda: little drawn out posteriorly, dark, rectangular, with some few hairs surrounding the caudal opening.

Apterous Viviparous Female.—Average length 1·616 ± 0·002 mm., pale brown with a whitish mealy coat. Head: broadly convex between the bases of antennæ which are 0·256 mm. apart. Eyes: with three facets only. Antennæ: 5-6 segmented; average length of first 0·064, second 0·096, third 0·080, fourth 0·080, fifth 0·064 and flagellum measured 0·144 mm. Sensoria: only two primary sensoria, one on the apex of the fifth and the other at the apex of the base of the flagellum. Legs: pale yellow, uniformly covered over with short hairs; average length of fore, mid and hind tibia measured 0·272, 0·288 and 0·400 mm. respectively. Abdomen: pale, dusky brown with a small amount of mealy coat. Cornicles: absent. Cauda: same as in alatæ. Host: heavy infestation on cotton plants was observed at Dharwar during January 1955.

Entomological Laboratory, College of Agriculture, Dharwar, *October* 20, 1955. H. L. KULKARNY.

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COLOUR AS A FACTOR INFLUENCING THE SETTLEMENT OF BARNACLES

THE reaction of the larvæ of marine fouling organisms to colouru will be of commercial value in determining colours of anti-fouling paints. To study the influence of colour on the settlement of barnacles (a dominant member of the fouling complex at Madras) six glass plates of 16" × 10" which were coated with non-toxic paints of red, black, white, green, blue and grey and a seventh plate without any coating of paint were immersed at the New North Quay of the Madras Harbour. Similar sets of painted panels were immersed at four other sites in the main harbour and two sites in the boat basin.

The number of cyprid larvæ of *Balanus amphitrite variegatus* settling on both the sides of these plates during 5-day periods at the different sites were counted. The experiment was repeated ten times throughout the year. Similar experiments were conducted for the larvæ of *Balanus tintinnabulum tintinnabulum* and *Chthamalus stellatus stellatus* on the

TABLE I

Name of Species	Black	Red	White	Green	Blue	Grey	Plain glass plate (without colour)
Balanus amphitrite variegatus ..	4250	3964	3318	1262	1761	1026	2829
Balanus tintinnabulum tintinnabulum ..	3438	3492	3244	1033	1388	665	3291
Chthamalus stellatus stellatus ..	4182	3206	3589	1369	1660	599	2141

Royapuram Shore. The data are averaged and presented in Table I.

A perusal of Table I shows that while red, black and white attracted large numbers, blue, green and grey plates had far fewer, grey panel being the poorest. Visscher,[3] Visscher and Luce,[4] Pomerat and Reiner,[2] and Weiss[5] found cyprids preferring dark background whereas in the present series of experiments, the numbers settling on white equalled those settling on black. Though the reaction of the cyprids to colour may lead us to a complex of several factors of behaviour involving the quantity of radiant energy absorbed or reflected[3] as well as the idiosyncrasies of the living organisms, it is felt that if grey or blue or green colours, which do not contrast against the background, are used in anti-fouling paints, it will have greater effect in successfully preventing settlement of larvæ of foulers for a longer period.

I am thankful to Dr. C. P. Gnanamuthu for suggesting the problem and help in the preparation of this paper.*

University Zoology Lab., A. DANIEL.
Chepauk, Madras,
November, 1955.

* This note forms a part of the thesis accepted for the Ph.D. degree of the University of Madras.

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CONTROL OF KHAPRA (*TROGODERMA GRANARIUM* EVERTS)

Trogoderma granarium Everts, is considered to be one of the most difficult enemies of foodgrains to control. The damage, however, is caused only in the larval stage. Hence the attention of most of the workers has so far been focussed on the larval stage. The larvæ feed on a large variety of grains, withstand long periods of starvation, live in foodgrain with very low moisture content and are in the habit of hiding in cracks and crevices. These special characters coupled with the extraordinary resistance of these larvæ to practically all the insecticidal chemicals tried so far have led people to believe the prospects of its control to be quite gloomy. Lately queries for all available information about this pest have been received from several quarters including U.S.A. where this pest is spreading and is causing great concern.

Recently our studies on stored grain pests confirmed the unusual resistance[1] of Khapra larvæ to the contact toxicity of a number of modern insecticides but to our pleasant surprise it was observed in a preliminary experiment by one of the authors (S. P.) and S. S. Bhatia that some of these insecticides when mixed with wheat samples (DDT and toxaphene each at 83, 42 and 21 p.p.m. and *gamma* BHC, aldrin, dieldrin and chlordane each at 42, 21 and 10 p.p.m.) effectively checked the increase of infestation by this pest. This preliminary observation necessitated more detailed studies on the susceptibility of this species in stages other than the larval stage. Now it has been found that the resistance of the larval stage is lost even at the pupal stage, there being no emergence from a large percentage of pupæ kept on emulsion films (prepared from 1-2% emulsions) of lindane, aldrin and dieldrin. The adults that emerge are also quite susceptible to the films of these insecticides and also to those of DDT and toxaphene. Also the adults that emerge from pupæ sprayed with emulsions or kept on emulsion films of aldrin, dieldrin, toxaphene and lindane either do not lay eggs or lay a much reduced number of eggs, depending upon the concentration of the insecticide. Dusts and dust films are comparatively less effective. These studies have clearly indicated that these modern insecticides can be confidently used to disinfest godowns, to check the spread of, and to keep the grain meant for seed purposes safe from this otherwise dreaded pest. Details will be published elsewhere.

Division of Entomology, S. PRADHAN.
Indian Agri Res. Inst., G. C. SHARMA.
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ON THE AFFERENT BRANCHIAL ARTERIES IN *MASTACEMBELUS ARMATUS*

THE order Mastacembeliformes (Opisthomi) of Berg,[1] contains only one family Mastacembelidæ which is represented in Uttar Pradesh only by the genera *Mastacembelus* and *Rhyncobdella*. The anatomy of these fishes is, therefore, both instructive and interesting, since they represent an entire order. Notwithstanding this, little published work on their morphology exists, except by Mitra and Ghosh[2] on the gross anatomy of the family Opisthomi. There are only two species of *Mastacembelus* which have been recorded from Uttar Pradesh, *viz.*, *M. armatus* and *M. pancalus*. Although a good deal of work has been done on the *true eels* (Anguilliformes or Apodes), very little attention has been paid to the *spiny eels* which are found abundantly in India. Wu, Yih and Chang[3] have reported aerial respiration in *M. aculeatus*, a Chinese species, but they have not worked out the circulation of blood in the respiratory region of the fish.

The present work appears to be the first detailed account of the afferent branchial arteries in *Mastacembelus armatus* Lecepede (Actinopterygii; Mastacembeliformes; Mastacembelidæ). The ventral aorta in this fish extends from the pectoral girdle up to the ventral end of the first branchial arch, where it terminates by dividing into the first pair of afferent arteries. The ventral aorta expands to form a sinus-like structure (Fig. 1)

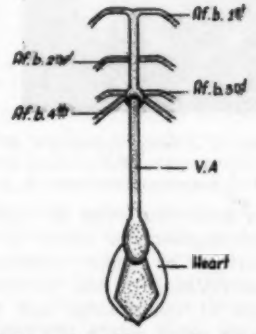

FIG. 1. Afferent branchial arteries in *Mastacembelus armatus*, *Af. b.* 1st – *Af. b.* 4th—Afferent branchial arteries 1–4 ; *V.A.* – Ventral aorta.

which gives out two pairs of afferent arteries, the third and fourth. In between the third and first pair of afferent arteries, the second pair of afferent arteries is given off in level with the ventral end of the second branchial arch.

Each of the second pair of afferent arteries have a separate origin (Fig. 2) from the late-

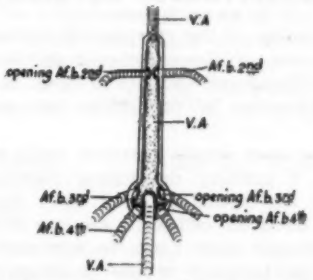

FIG. 2. A part of the ventral aorta cut open to expose the openings for the afferent arteries in *M. armatus*. *Af.b.* 2nd. – *Af.b.* 4th —Afferent branchial arteries 2–4 ; *V.A.* – Ventnal aorta.

ral walls of the ventral aorta. The third and fourth pair of afferent arteries have their origin from the expanded portion of the ventral aorta. On exposing this region, four openings on the dorsal wall are observed, each leading to one of the four arteries. The four openings are closely situated, the openings of the third and fourth afferent arteries of each side being simply separated by a membranous partition. The third and fourth pairs of afferent arteries do not arise from the same aperture as observed by Mitra and Ghosh but each arises from a separate aperture of its own.

In the case of *Labeo rohita*,[4] all the four pairs of afferent arteries have separate origin from the lateral walls of the ventral aorta. In *Ophicephalus striatus*,[5] the third and fourth pair of afferent arteries originate from a common aperture in the roof of ventral aorta. It appears that in *Mastacembelus armatus* an intermediate condition is present in which the opening of the third and fourth pairs of afferent arteries have come closer, but have not fused as in *Ophicephalus*. My sincere thanks are due to Dr. S. M. Das for his valuable guidance during the conduct of the work.

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PECULIAR MODE OF ORIGIN OF POLYOVULAR POLLICLES IN *SEMNOPITHECUS ENTELLUS*

DURING studies on the cytoplasmic inclusions in the oogenesis of *Semnopithecus entellus* (the common Himalayan langur) interesting stages in the formation of polyovular follicles were observed.

In some cases simple partition walls are laid down in a primary developing oocyte which result in the formation of 3 or 4 daughter-oocytes. Later on, cell-walls are laid down and more follicular cells come to surround them. This is the simplest of the processes but in other cases unique and interesting features of the role of the follicular cells in the production of polyovular follicles have been observed. Initially few follicular cells come to surround a developing oocyte as a single layer. As the oocyte grows, these follicular cells invade the oocyte at certain spots and this process goes on till the follicular cells are successful in dividing the original oocyte into two daughter ones. Later on definite cell-walls are laid down and more follicular cells join up to form polyovular follicles.

The third process provides some interesting features, and has not been reported by previous workers. During the initial stages, follicular cells proliferate on one side to produce a bulging mass. Later on some of the central follicular cells of this bulging mass get dissolved out, which result in the appearance of a vacuole. This clear space goes on enlarging till it reaches the zona pellucida of the original oocyte. At this state, a portion of the zona pellucida, touching the clear space, gives way as a temporary phase and then there is free communication between the two which facilitates the transfer of protoplasmic and nuclear material from the primary oocyte to the developing oocyte. The appearance of the nucleus and cytoplasmic inclusions in the developing oocyte on the side adjacent to the primary oocyte leave little doubt that they must have come from the primary oocyte. Later on, the broken zona pellucida of the original oocyte gets repaired and simultaneously another cell-wall is laid down around the developing oocyte. All these stages are shown in Figs 1-4.

The resulting biovular follicle in which the ova are in mutual contact can be fitted easily in the polyovular follicle classified as Type II by Hartman. Such polyovular follicles with no sign of liquor folliculi have also been observed by workers like Van Beneden, Schulin, Bouin and Schron. Polyovular follicles showing intervening granulosa cells (Type I) and egg-cells in linear arrangement (Type III) have not been observed in the present case.

FIG. 1. Section showing primary oocyte (P.O.) and proliferation of follicular cells (Pr. F.) (Shridde method, iron-alum-hæmatoxylin), ×125.

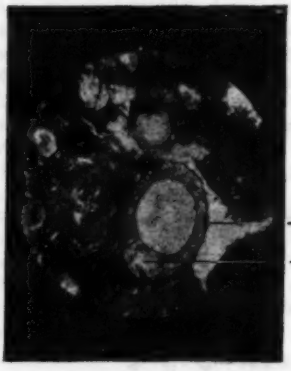

FIG. 2. Section showing appearance of clear space (C.S.) in the follicular cells (F.C.) of the primary oocyte (Shridde method, iron-alum-hæmatoxylin), × 130.

Further, a distinction must be made between a typical development of ovum in an atretic follicle described by some workers and the present observations. In the former, amitotic fragmentation of the nucleus and division of the protoplasm occur within the zona pellucida of the oocyte and the resulting picture shows several bodies of varying size with distinct nuclei occurring in the interior of the zona pellucida which finally gets disorganised for its destruction. But, in the present observations, I do not find such a condition. On the contrary, a portion of the zona pellucida gives

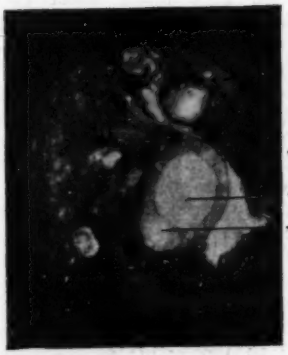

FIG. 3. Section showing the clear space (C.S.) touching the primary oocyte (Shridde method, iron-alum-hæmatoxylin), × 125.

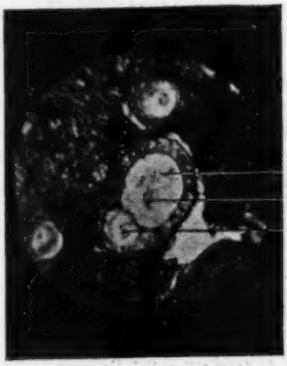

FIG. 4. Section showing the primary oocyte (P.O.) with the nucleus (Nuc.) and the secondary oocyte with the nucleus (Nuc.S.) enclosed by the follicular cells (Shridde method, iron-alum-hæmatoxylin), ×125.

way temporarily for the transfer of the protoplasmic and the nuclear material to the developing oocyte. It soon gets organised and so in Fig. 4 we find two well-developed oocytes, enclosed by follicular cells, showing no sign of retrogression. Moreover there are no traces of fat droplets in these oocytes (appearing either as fatty vacuoles due to fat being easily washable by xylol or more resistant black osmicated fatty globules) even after the use of osmic acid, an important component of Shridde's fixative. So these observations are clearly demarcated from the phenomenon of atresia where the first sign of degeneration is marked with the appearance of fat droplets in the egg-cell as well as the shrinking and collapsing of the oocyte and the zona pellucida. Atresia is a degenerating process whereas the present observations are of formative stages.

These observations are also important in focussing the attention on the role of the follicular cells in the production of polyovuly in the common "Himalayan Langur".

A detailed paper discussing the phenomenon of twinning in mammals will be published elsewhere.

Dept. of Zoology, HRISHI BHU TEWARI.
The University, Lucknow,
July 28, 1955.

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2. Hartman C. G., *Amer. J. Anat.*, 1926 **37**, 1.
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* Originals not seen.

NOTES ON THE GERMINATION OF TURIONS IN *HYDRILLA VERTICILLATA* PRESL.

SEVERAL aquatic plants are known to develop 'winterbuds' or 'turions', to tide over adverse conditions during the winter months and to ensure vegetative propagation.[1-3] Two types of turions, namely, underground and floating, the former developing on the positively geotropic shoot tips of axillary branches and the latter in the shoot tips of axillary branches on the submerged parts of the stems much above the mud level have been recorded in *Hydrilla verticillata*.[3] The axillary branches, which bear the underground turions terminally, are generally long and are present nearer the mud level, so that just after their formation they bend, penetrate the soil and form the turions at their tips. The green turions appear axillary owing to their very short stalks. The morphology of the floating green turions has been described by the present author in an earlier contribution.[4] No account of the germination or autecology of either types of turions of *H. verticillata* appears to be on record.

While studying the autecology of *H. verticillata* in fishery waters at Cuttack, Orissa, observations were made on the different stages of germination of both the types of turions under natural conditions and also in earthenware tubs containing mud and water and a brief report of the same is given in this note. This study has some bearing on possible control measures of the plant which often quickly overgrows in fishery waters.

Ordinarily a larger number of underground turions are developed in a plant than the green turions. According to Lakshmanan,[2] both the

types of turions are of the same size but it is observed that in the fully formed condition the length of green ones range from 3-12 mm. and the underground turions are generally larger in size and usually measuring from 4-15 mm. in length. The other distinguishing characters of these two types of turions have been given by Lakshmanan.[2]

When fully formed, the green turions drop on the bottom mud and the underground ones also get detached from the plant. In experimental earthenware tubs the turions were observed germinating within 8-12 days after being detached from the plant.

When shed, the green turions are generally found in the surface layers of the bottom soil and they germinate into small plants which are generally characterised by very short internodes with green, whorled leaves and roots (Fig. 1, C). Rarely, more than one shoot may

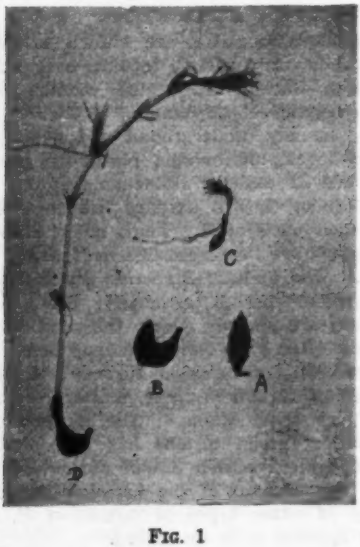

FIG. 1

A—Mature green turion.
B—Mature underground turion.
C—Germinating green turion with short internodes, green leaves and typical roots.
D—Germinating underground turion with long internodes and the roots developed at the point of emergence from the bottom mud.

also be seen coming out of a turion. The underground turions are found in the deeper layers of mud, even upto a depth of about 6-7". When the turions are buried deep, the germinating shoot elongates and bears long internodes and pale rudimentary leaves till it reaches the surface of the bottom mud (Fig. 1, D). Roots, which are adventitious, are also not ordinarily formed till the germinating shoot protrude from the bottom mud and develops green leave Once the germination commences, it takes onl about 12-14 days for the formation of a full developed plant.

Both the turions are present on the plant i abundance during the period December-January. Detached turions were observed fro the end of April onwards. Large-scale shedding of both the types of turions from th parent plants was observed from the beginnin of May to the end of June. Almost all th turions are shed by the end of this period. I natural ponds, germination commences fro the middle of May. Newly germinated plant are abundant in the pond by the middle June.

As far as the author could make out, large percentage of the newly developed plant results from the germination of both the type of turions. Whether seeds, if any, also play significant role in tiding over adverse conditions and in the propagation of the plant i under investigation.

I am indebted to Mr. K. H. Alikunhi fo helpful suggestion in this study.

Central Inland Fisheries Research Station, Calcutta-7, *November* 22, 1955. EVA MITRA.

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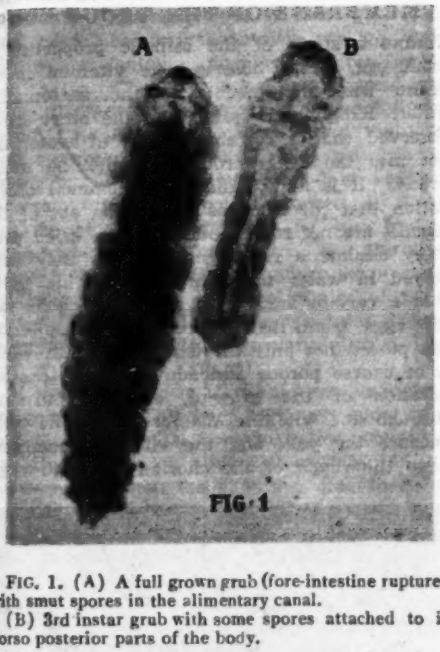
RECORD OF THE BLACK BEETLE, *PHALACRUS IMMARGINATUS* CHAMP. FEEDING ON SUGARCANE SMUT

DURING August of this year, examination o smutted whips of sugarcane revealed the presence of a number of small holes in the membrane, and also of some black shining beetle which were briskly moving about. Subsequen studies showed that whitish grubs of differen ages were concealed in the smut layer betwee the membrane and the columella of the smut ted whip. As a result of their being embedde in the fertile layer, plenty of smut spores wer seen attached to all parts of their body. Dis section of some of them showed the presenc of spores (Fig. 1, A and B) in the alimentary system which suggested that the grubs feed o the spores. The spores collected from the alimentary canal appeared to be normal but faile to germinate when cultured artificially.



FIG·1

FIG. 1. (A) A full grown grub (fore-intestine ruptured) with smut spores in the alimentary canal.
(B) 3rd instar grub with some spores attached to its dorso posterior parts of the body.

A study of the life-history of the beetle was also made under laboratory conditions. The eggs are whitish and oblong when freshly laid, but turn brownish on hatching, measure 0·5-0·75 mm. long and 0·2-0·28 mm. broad. Eggs take 7 or 8 days to hatch. The grubs, on hatching, move about actively for some time and then enter the whip by puncturing the silvery membrane and establish themselves in the smutted layer, where they feed on the smut spores till they are fully grown. The fully grown grub is white in colour measuring 5·0-5·5 mm. in length and 1·3-1·5 mm. in breadth with three pairs of prolegs. When nearing pupation, the grubs descend and lodge themselves at the transverse mark, i.e., at the junction of the leaf with the stem. They cease to feed, and remain quiescent for a time before pupating. The pupa is white in colour, 2·8-3·3 mm. long and 1·5-1·7 mm. broad, broader at the anterior end. The pupal period, as observed in the laboratory, varies from 8-9 days. The adults, when freshly emerged are brownish white and inactive, but turn into shining black beetles after some time. The adult is convex, 2·5-3·5 mm. long and 1·5-2·3 mm. broad. The antennæ are clavate and 11-segmented. Tarsus 4-jointed with a pair of claws. The elytra covers the abdomen entirely.

This is presumably the first record of the occurrence of *Phalacrus immarginatus* Champ. on sugarcane smut. Grateful thanks are due to Shri N. L. Dutt for his guidance and encouragement. The author is indebted to Dr. M. L. Roonwal (Dehra Dun), for kindly identifying the insect.

Sugarcane Breeding Inst., R. A. AGARWAL.
Coimbatore, October 10, 1955.

EFFECT OF HORMONES ON GERMINATION IN LOQUAT POLLEN

IN the course of his studies on parthenocarpy in loquat (*Eriobotrya japonica*) the author observed very poor setting in the flowers borne in the months of August and September. The production of pollen was also found to be poor in those months. It was therefore considered desirable to find if the germination of pollen and the elongation of the pollen tube could be accelerated with the help of growth substances.

The freshly-collected pollen were germinated in 1% sugar solution on cavity slides and, where necessary, the growth substances were applied in that medium. The slides were sealed with liquid paraffin, so that they could be easily opened and sealed. The germination of the pollen was allowed to continue only for 90 minutes and the observations were made at 30 minutes interval. In the end a drop of acetocarmine was introduced in the culture drop for staining and killing the tubes.

Germination of pollen was recorded by counting the total number of pollen in a field and then recording the number of germinated pollen in the same field. Figures in tables indicate the values obtained from observations in four fields. The length of the pollen tube was measured with the help of a standardised

I. EFFECT OF NAPHTHALENE ACETIC ACID

TABLE I

Effect of alpha naphthalene acetic acid on germination of pollen and the elongation of the pollen tube

Concentration p.p.m.	Time in mt. for germination	Percentage of germination	Length of pollen tube
0	67	32·5	3·07
5	68	36·3	3·32
10	67	26·0	2·97
15	90	7·2	..

occular micrometer plate, and figures indicate mean of 30 values.

Figures in Table I indicate that 5 p.p.m. concentration is the best so far as germination and the length of pollen tube were concerned. The higher concentrations, i.e., 10 and 15 p.p.m., were not so beneficial; the latter was actually toxic as in that treatment only 7·2% germination was observed after 90 minutes. In the lower concentration the germination started in 68 minutes.

II. Effect of Beta Indolyl Acetic Acid

Table II

Effect of beta indolyl acetic acid on the germination of pollen and the elongation of the pollen tube

Concentration p.p.m.	Time in mt. for germination	Percentage of germination	Length of the pollen tube
0	30	46·8	2·3
5	30	41·0	2·33
10	30	59·2	2·05
15	60	53·7	1·83
20	60	54·6	1·71
25	60	35·0	1·5

The germination started within 30 minutes in 0, 5 and 10 p.p.m. concentrations and within 60 minutes 15, 20 and 25 p.p.m. treatments. Highest percentage of germination was observed in 10 p.p.m., concentration beyond which there was a decline in the extent of stimulation. It was actually less than the control in the 25 p.p.m. treatment.

The growth of pollen tube showed a progressively adverse effect with the increase in concentration of the growth substance irrespective of the fact that some concentrations actually enhanced the percentage of germination (10, 15 and 20 p.p.m.). The figures in Table II suggest that treatment with growth substance has a tendency to arrest the elongation of the pollen tube. The findings are in line with those of Addicot[1] who suggested that the pollen germination and tube elongation are two distinct physiological processes requiring different factors. The shortage in the length of pollen tube may be due to the initial delay in the germination of pollen in higher concentrations. This aspect, however, needs further investigation.

My thanks are due to Dr. L. B. Singh for help during the work and to Dr. K. M. Aiyappa for kindly going through the manuscript.

Co-ordinated Scheme for Research on Micronutrients, Gonikopal (S. Coorg), *October* 6, 1955.

N. N. Dikshit.

1. Addicot, F. T., *Plant Physiol.*, 1943, **18**, 270.

PERMEABILITY OF THE VITELLINE MEMBRANE OF THE TROUT EGG

During a study of the osmotic properties of trout egg, Gray[1] observed its vitelline membrane was impermeable to the surrounding water. Krogh and Ussing,[2] on the other hand observed that a certain amount of water did get into the eggs through its vitelline membrane. It is now a matter of common observation that the eggs, as they come out of the female, are not round, but look like dried peas. They assume a round shape when they have stayed in water for 12 hr. or so. This shows that a certain amount of water has gone into the eggs from their surrounding. This water has passed not only through the chorion which is of course porous and admits water to allow aeration of the growing embryo, but also through the vitelline membrane to the yolk because the yolk and the vitelline membrane have the shape of the chorion when the egg

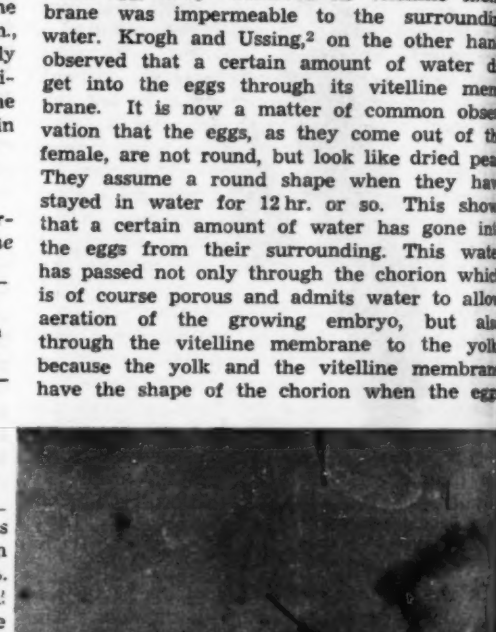


Fig. 1

Photo-mircograph of a part of a frozen section after its proteins have been removed with pepsin. The row of small dots (marked with arrows) indicates the lipoids of the vitelline membrane. The big dots indicate the lipoids on the surface of the yolk. *Fixative*: Calcium-formaldehyde. *Age of the egg*: Thirty hours after laying. Similar section of an egg just after laying does not show the droplets in the place of the vitelline membrane.

are laid and become round with it when the eggs have remained in water overnight. It has also been observed that there are no movements in the vitelline membrane of the freshly-laid eggs. The rhythmical movements start when the eggs have stayed in water for some time.[3] The histo-chemical study of the vitelline membrane shows that it is mainly composed of proteins. In freshly-laid eggs the membrane has no lipoids attached to it and can be completely digested by the protein-digesting enzymes, like pepsin. But the vitelline membrane of the eggs which have stayed in water overnight or more carries a certain amount of lipoids. When it has been digested there are left in its place certain tiny droplets of the lipoids (Fig. 1).

It seems to be a probable explanation of the contradictory findings of Krogh and Ussing, and Gray that the former studied green ova and the latter took advanced eggs for his experiments. When the eggs are laid, there are no lipoids attached to the vitelline membrane and it allows a certain amount of water to get into the yolk. Later on rhythmical movements start in the membrane; and it rubs against the yolk and gets soaked in the lipoids present on the yolk surface in the form of oil droplets and becomes impermeable to water.

Dept. of Zoology, DAYA KRISHNA.
Jaswant College, Jodhpur,
October 26, 1955.

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2. Krogh, A. and Ussing, H. H., *Ibid.*, 1937, **14**, 35.
3. Rothschild, Lord, Personal Communication.

A DOMINANT (TWIN-BOLLED) 'CLUSTER' IN HIRSUTUM COTTON

THE cluster habit, responsible for the production of two or more bolls at sympodial nodes, has been considered to be recessive in literature on cotton.[1,2] However, the twin-bolled segregate described below was found to behave as a recessive as well as a dominant in segregations.

The cluster segregates occurred in the cross, (Co_2 × Pima)F_1 × B.C. 68 from the very first segregating generation, but their counts were first taken in three F_6 cultures grown in 1953-54. Study of the segregations was followed up in 1954-55. The data are presented in Table I.

TABLE I
Showing cultures derived from normal plants

Culture No.	Normal	Cluster	Total
	F_6 cultures		
2442	10	5	15
2452	21	4	25
2489	10	5	15
	F_7 Cultures		
2442[a]–2085	39	7	46
–2086	15	3	18
–2089	19	2	21
–2094	6	15	21
2452[b]–2102	19	9	28
2489[c]–2113	17	5	22
–2116	1	8	9
–2117	10	2	12
	Cultures derived from cluster plants		
2449 –2081	2	8	10
2442[d]–2088	1	9	10
2489 –2118	5	3	8
–2119	2	8	10
	10	28	38

a—Two cultures from this family did not segregate; *b*—Seven cultures from this family did not segregate; *c*—One culture from this family did not segregate; *d*—One culture from this family did not segregate.

It will be seen from the data in Table I that while cluster segregates have occurred in cultures derived from normal plants, cluster cultures have thrown normal segregates. This would indicate that cluster in this case is dominant to normal but, when in association with an inhibitor, as seems to have happened in the F_6 cultures, 2442, 2452 and 2489 and certain of their derivatives, its expression is also modified to normal. Such a conclusion is inevitable, though plant numbers in the above-mentioned cultures are too small to prove that the ratio, normal : cluster is 13 : 3 and not 3 : 1. It is further confirmed by the fact that the 3 and 7 plants which resulted respectively from the crosses, (i) 2494—6 (cluster) × 2442—5 (normal), and (ii) 2494—8 (cluster) × 263—1 (normal) were of 'cluster' habit.

Agri. Res. Station, N. R. BHAT.*
Surat, *November* 1955. C. T. PATEL.

* Present Address:—Central Tobacco Research Institute, Rajahmundry.

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REVIEWS

X-Ray Diffraction in Polycrystalline Materials. Edited by H. S. Peiser, H. P. Rooksby and A. J. C. Wilson. (The Institute of Physics, London), 1955. Pp. 725. Price 63 *sh.*

Several books are available on X-ray crystallography but none of them deal in any detail with the study of powder specimens. The book under review is therefore particularly welcome, since it contains in a single volume the scattered information on this subject available only in various journals.

Some 30 different authors, mostly drawn from Great Britain, have contributed the 32 chapters in the book, which is divided into three parts. The first part deals with experimental methods. After an introductory account of the principles of X-ray diffraction and of X-ray generators and methods of film measurement by the editors, detailed accounts are given of the use of the standard Debye-Scherrer camera, focussing cameras, back-reflection and low-angle cameras, special methods for high and low temperatures and methods for studying preferred orientation. There is also an excellent chapter on Counter Diffractometers, dealing with the use of Geiger counters, proportional counters and scintillation counters.

Part II is concerned with the interpretation of the diffraction data. The special topics considered are the determination of the unit cell, precision determination of lattice parameters, measurement of intensity of the lines and of line profiles and scattering by non-crystalline media such as proteins. The use of this technique for identification of materials is discussed in a separate chapter, while two chapters are devoted to the preferred orientation of metals and fibrous materials, and the effect of this on the X-ray pattern.

Part III deals with applications. A wide variety of topics is covered, such as the use of the powder method in an industrial laboratory, in mineralogical research, for the study of proteins and high polymers, in ceramic research, in metallurgy and in researches associated with atomic energy. The volume concludes with a chapter on the properties of X-ray films and the technique of photographic photometry. A. J. C. Wilson has contributed a series of most useful appendices, containing tables of data often required in these studies.

Extensive references to the original literature is given throughout the book. The editors must be congratulated on the way in which they have welded the various articles together. The volume is sure to be appreciated by every X-ray crystallographer and industrial physicist.

G. N. RAMACHANDRAN.

An Introduction to Reactor Physics. By D. J. Littler and J. F. Raffle. (Pergamon Press, Ltd., London), 1955. Pp. viii + 196. Price 25 *sh.*

In the past few years, rapid progress has been made in the field of reactor physics. Several monographs and books have been written on this subject notably Soodak and Campbell's "Elementary Pile Theory", the MIT volumes and "The Elements of Nuclear Reactor Theory" by S. Glasstone and M. C. Edlund. This book serves as a good introduction to scientists who have no background of nuclear physics. It is based on a set of declassified lectures given by the authors to the Reactor School at the Atomic Energy Establishment, Harwell.

The first five chapters deal with the structure of matter and elementary nuclear physics in a simple way. Subsequent chapters contain an account of slowing down and diffusion of neutrons in moderators. A full account has been given of the calculations used in evaluating the critical size of a gas-cooled, graphite-moderated, natural uranium reactor. The effects of air-gaps, reflectors, temperature and poisons on reactivity of the reactor have also been discussed. The latter chapters deal with the special topics of shielding, instrumentation for a reactor and the damage done to structural materials when subjected to high radiation fluxes. There is also a concise appendix on the subject of radiation hazards.

The reviewer feels that apart from graphite moderator, some information regarding other moderators, *e.g.*, heavy water should also have been included. It would have been better to include more about neutron attenuation in the chapter on reactor shielding. The inclusion of more numerical problems would also have been useful.

The book contains a readable account of elementary reactor calculations and is quite

useful for pile-engineers and science students.

V. P. DUGGAL.

Relativity for the Layman. By James A. Coleman. (The William Frederic Press, New York), 1954. Pp. 131. Price $2.75.

As the title implies, this book is intended to be a simple presentation of relativity theory for those who have not had any special training in physics or mathematics. This is done by means of an essentially experimental approach to the subject. More than two-thirds of the book deals with the difficulties encountered in pre-relativity physics and how they were solved by special relativity. This is followed by chapters on the general theory, relativistic cosmology and the basic ideas of the unified field theory.

The author has eminently succeeded in his attempt to present the subject to a layman. The treatment is mostly descriptive, with very few equations; but at the same time it is perfectly logical and is developed in a rigorous manner.

A minor criticism may be made that no account is given of the expanding universe in the chapter on cosmology. The book deserves to be read not only by the layman, but by every student of science. Even students taking a course in relativity could profitably read the book to get a better overall picture of the subject.

Static and Dynamic Electron Optics. By P. A. Sturrock. (Cambridge University Press), 1955. Pp. x + 240. Price 30 *sh.*

This book of about 200 pages is one of the Cambridge monographs on Mechanics and Applied Mathematics and gives a compact exposition of the theory of electron optics. The book is divided into two parts. Part I, on 'static electron optics' deals with the focusing of charged particles in static electromagnetic fields and is concerned with electron lens systems and the design of modern instruments like beta-ray spectrographs and mass-spectrographs. General procedures based on the older concepts like the Lagrange and Poincaré invariants and Hamilton's characteristic functions are set out for use in the investigation of electron optical problems of image formation and in the evaluation of the properties of machines designed for focusing charged particles.

Part II on 'dynamic electron optics' is concerned with the focusing of charged particles in time-dependent electromagnetic fields, i.e., with particle accelerators. One chapter of this part deals with uniform focusing in accelerators while the other is concerned with 'the strong-focusing principle', the synchrotron having been considered in detail. The basis of mathematical approach to these problems is to regard time as 'just another co-ordinate' and to evaluate the stability of a machine by the application of the method of characteristic functions, developed in Part I, on 'static electron optics'.

This book is of particular interest because one of the author's aims has been to relate the theory of electron-optical instruments and particle accelerators to classical optics and dynamics. It will, no doubt, be useful to all those engaged in the design, maintenance and use of modern machines for work in nuclear physics, besides serving as a theoretical guide in electron-optics.

B. V. THOSAR.

Advances in Carbohydrate Chemistry, Vol. VIII. (Academic Press, Inc., Publishers, New York, N.Y.), 1953. Pp. xvii + 408. Price $10.00.

The volume begins with an obituary of the late Sir James Irvine, one of the great pioneers of carbohydrate chemistry, his contributions being presented in brief outline.

J. M. Sugihara discusses the relative reactivities of the hydroxyl groups of sugars in the light of configurational relationships and neighbouring group effects and gives a detailed account of work on the selective etherification, selective esterification and hydrolysis and selective oxidation of sugars. The chapter on 2-deoxysugars deals with the occurrence, isolation and methods of detection of this group of compounds, some of which are of great biological importance. Methods of synthesis of 2-deoxysugars and the chemistry of transformation products obtained by oxidation, reduction, esterification and glycolysis of alcohols and amines are presented at length. The chapter on sulphonic esters of carbohydrates by R. S. Tipson gives an exhaustive account of this group of carbohydrate derivatives dealing with methods of preparation, their properties and reactions. This chapter will undoubtedly be the most useful in this volume to organic chemists in general. Two chapters deal with D-glucuronic acid, one on its synthesis and another on its mode of formation *in vivo*. The chapter on the trisaccharide, melezitose, presents the evidence which finally establishes it to be a glucoside of sucrose. Other chapters on the methyl ethers of D-mannose, on the composition of cane juice and molasses and on sea-weed polysaccharides will be of special interest to carbohydrate chemists.

The present volume comprising of contributions from leading workers in the field of carbohydrate chemistry and edited by the late C. S. Hudson and M. L. Wolfrom maintains the same high standard in scholarship and critical judgment characteristic of the earlier volumes in the series. T. R. G.

The Proteins—Chemistry, Biological Activity and Methods. Vol. II, Part A. Edited by H. Neurath and K. Bailey. (Academic Press, New York), 1954. Pp. viii + 661; Part B, Pp. viii + 662-1418. Price $ 14.00 and $ 16.50.

Vol. II of this treatise consists of Chapters 12 to 26 and the author and subject indices for both the volumes. The first chapter in this volume is concerned with nucleoproteins and viruses, contributed by R. Markham and J. D. Smith. The chemistry and physics of nucleic acids are treated first, and followed by a discussion of nucleoproteins and the relationship between nucleic acids and proteins. The various plant and animal viruses are also discussed individually. T. P. Singer and E. B. Kearney contribute the next chapter on the Oxidising Enzymes. This is followed by a series of chapters on various individual proteins, such as respiratory proteins (F. Haurowitz and R. L. Hardin), toxic proteins (W. E. van Heyningen), milk proteins (T. L. McMeekin), egg proteins (R. C. Warner) and seed proteins (S. Brohult and E. Sandegren). The problem of protein metabolism in plants is discussed by F. C. Steward and J. F. Thompson. C. H. Li has contributed the chapter on protein harmones, while W. L. Hughes has discussed the proteins of the blood plasma and lymph.

Part B begins with an article by W. C. Boyd on the subject of antigens and antibodies and the problem of immunity. The next two chapters deal with structure proteins. J. C. Kendrew discusses those belonging to the fibroin, keratin and collagen groups. The discussion is essentially physical and is concerned with the ultimate molecular structure of these proteins in relation to their properties. The chapter on muscle contributed by K. Bailey, on the other hand, deals more with the chemical and biological aspects. However, here also X-ray and electron microscopic studies have given some valuable information.

N. M. Green and H. Neurath have contributed an extensive review on proteolytic enzymes. The last chapter is concerned with the problem of protein synthesis and the incorporation and turnover of amino acids *in vivo*.

In a rapidly growing subject as this, it is impossible to make a book up to date. Already since the publication of these volumes important knowledge has been obtained regarding the structure of nucleic acids and nucleoproteins and of some proteins like insulin and collagen. The relationship between proteins and nucleic acids and their synthesis are being vigorously investigated. It is to be hoped that these expanding frontiers would be covered by the issue of supplementary volumes at suitable intervals. These however do not detract from the fact that the two volumes together form a comprehensive and authoritative account of the whole field of protein chemistry and the related physical methods of studying proteins.

G. N. RAMACHANDRAN.

(*i*) Alepisauroid Fishes. By N. B. Marshall. (*Discovery Reports*, Vol. XXVII), 1955. Pp. 303-36. Price 12 *sh.* 6 *d.* **(*ii*) Euphausiacea of the Benguela Current.** By S. P. Boden. (*Discovery Reports*, Vol. XXVII.) (Cambridge University Press), 1955. Pp. 337-76. Price 12 *sh.* 6 d.

(i) Dr. Marshall deals with Alepisauroid fishes. These large, swift, voracious, bathypelagic fishes, are little known. The *Discovery* collection is sufficiently extensive as to facilitate a review of their relationships. Of the six families included in the suborder Alepisauroidæ, six species belonging to three families are described. The different features of members of this suborder are compared with those of the other suborder myctophidæ which are bottom dwelling. The suggestion that the Alepisauroidea are not monophyletic is examined fully.

(ii) The number describes the adult and developmental stages of Euphausiids collected by R. R. S. *William Scoresly* during her eighth commission and first survey of the Benguela current off the coast of S.-W. Africa. Of the fourteen species recorded, species of *Nyctiphanes* and *Euphausia* resemble very closely those of the California current in all details and even distribution. Similarity in physical oceanographic conditions in the two upwelling areas as well as in phytoplankton populations and successions in the two currents are considered responsible for morphological similarities. But definite conclusions are possible only after the second survey.

The developmental phases of four of the species are described. The possibility of the oceanic species, with a tendency for suppression of the number of larval stages, reverting to greater larval variations when brought into

the coastal current is discussed. Valuable information regarding the different stages is also presented.

Both these parts render Vol. XXVII invaluable and worthy of a place in any marine biological library.

C. P. G.

International Review of Cytology. Vol. III. Edited by G. H. Bourne and J. F. Danielli. (Academic Press), 1954. Pp. v + 530. Price $9.50.

The *International Review of Cytology* has been offering a wide variety of fare to students of cytology and the present volume is no exception. There are interesting reviews on "The Nutrition of Animal Cells" (Waymouth), "Caryometric Studies of Tissue Cultures" (Bucher), "The Properties of Urethan Considered in Relation to Its Action on Mitosis" (Cornman), "The Significance of Enzyme Studies on Isolated Nuclei" (Dounce), "The Use of Differential Centrifugation in the Study of Tissue Enzymes" (Duve and Berthet), "Azo Dyes in Enzyme Histochemistry" (Pearce), "Microscopic Studies in Living Mammals with Transparent Chamber Methods" (Williams), "The Mast Cell" (Asbœ Hansen), "Elastic Tissue" (Dempsey and Lansing) and "The Composition of the Nerve Cell Studies with New Methods" (Brattgard and Hyden).

Over a decade back, Walter (1942), stated: "It is not enough for the geneticist to know the chromosomal mechanism at the beginning of his story and the Mendelian moral at the end of it. Between these two fields of investigation lies the no-man's land of somatogenesis which forms a major and least known part of the hereditary tale". The volume under review contains three articles on different aspects of the problem of differentiation. Gustafson presents some enzymatic aspects of embryonic differentiation. Mitochondria are considered to play a role in morphogenesis. Since paternal antigens were detected in the mesenchyme blastula of hybrid sea-urchin larvæ (Harding, Harding and Perlmann, 1954) it has been suggested that the nucleus could be presumed to take an active part in development at least by that time (p. 312).

The composition, structure and functional significance of giant salivary and lampbrush chromosomes still remain controversial in spite of the fact that the first reports on these structures date back to 1881 (Balbiani) and 1892 (Ruckert). After a critical review, Alfert considers that the peculiar organization of the lampbrush chromosomes may be "to supply the oocyte with numerous materials necessary for the growth of the embryo"....."In polytene chromosomes, this activity is restricted to definite regions which differ in nuclei of various tissues according to specific cell requirements" (p. 163).

The review, "How Many Chromosomes in Mammalian Somatic Cells?", by Beatty is thought-provoking. He emphasizes the necessity for classification of tissue into germinal (-gonia and -cytes) and somatic. "Are we to continue indefinitely with the suspicion that smear and squash techniques damage somatic mitoses (though not those of germ cells) and give an untrue appearance of inconstancy; that sections also give untrue pictures of somatic chromosomes (but not those of germ cells) by loss of parts of mitoses and difficulty in observation?"

A rapproachement between the Western and Eastern schools of genetics is desirable and in that context the following observations of Beatty deserve serious attention. "Eastern genetics, which visualizes only a minor role for the chromosomes in heredity and development, is predisposed to accept somatic inconstancy. Western genetics, which believes in a more detailed control of development and heredity by chromosomal determinants, is inclined to suspect reports of somatic inconstancy. In fact, somatic inconstancy is quite reconcilable with Western genetics. Western genetics is already committed, with certain obvious reservations to belief in a Weismannian isolation between soma and germ cells, and the chromosomal constitution of the somatic cells need not necessarily affect the process of passing unit characters from one generation to the next" (p. 187).

The volume would constitute an important addition to any library.

M. K. Subramaniam.

Some Extinct Elephants, Their Relatives and the Two Living Species. By P. E. P. Deraniyagala. (Ceylon National Museums Publication), 1955. Pp. 101 (with 48 Plates and 13 Text-Figs.). Price Rs. 6.

This publication is a mine of information to all concerned with the study of one of the most interesting orders, the Proboscidea. Both the extinct and the living species are dealt with.

A fair amount of space is devoted to systematics and palæontology, and these portions of the work must prove of greater interest to

those who have access to good museum and library facilities. Of particular interest to the field naturalist and others are the descriptions and accounts of the living species in Ceylon itself, with which the author is obviously extremely well conversant. The life-history. habits, capturing and training of the elephant in Ceylon are vividly described and profusely illustrated—though many of the photographs could have been of a higher standard.

While admiring the author's vast fund of knowledge, his untiring energy and his versatility (the sketches and many of the photographs are his own), one cannot help feeling that his enthusiasm for his subject may have lured him into enumerating too many subspecies. For example, only three living subspecies of *Elephas maximus* are listed by T. T. S. Morrison Scott of the British Museum of Natural History in his Check List, whereas the writer of this publication recognises eight or possibly nine.

The present volume is a little brief as the author himself confesses, but it has served to stimulate interest in a field worthy of exhaustive and intensive research. E. P. G.

Books Received

Humidity. By H. L. Penman. (The Institute of Physics, London, S.W. 1), 1955. Pp. 71. Price 5 *sh.*

Principles and Practice of Field Experimentation. By John Wishart and H. G. Sanders (Commonwealth Agricultural Bureaux Farnham, England), 1955. Pp. 133. Price 21 *sh.*

Physics of Fibres. By H. J. Woods. (The Institute of Physics, 47, Belgrave Square, London), 1955. Pp. 100. Price 30 *sh.*

Synthetic Drugs. By H. Ronald Fleck. (Clever Hume Press, Ltd.), 1955. Pp. viii + 380. Price 70 *sh.*

Organic Insecticides—Their Chemistry and Mode of Action. By Robert L. Metcalf. (Interscience Pub.), 1955. Pp. ix + 392. Price $ 8.50.

International Review of Cytology, Vol. IV. Edited by G. H. Bourne and J. F. Danielli. (Academic Press, Inc.), 1955. Pp. vii + 418. Price $ 9.00.

Antibiotics in Nutrition—Antibiotics Monographs, Vol. IV. By Thomas H. Jukes. (Interscience Publishers, Inc.), 1955. Pp. 128. Price $ 4.00.

Chemical Engineering, Vol. II. By J. M. Coulson and J. F. Richardson. (Pergamon Press, Ltd.), 1955. Pp. xvi + 387-975. Price £ 3.

Hydrogen Ions—Their Determination and Importance in Pure and Industrial Chemistry, Vol. I. Fourth Edition. By Hubert T. S. Britton. (Chapman & Hall), 1955. Pp. xix + 476. Price 70 *sh.*

USE OF RADIOACTIVE TRACERS IN THE STUDY OF PLANT PHYSIOLOGY

INTERESTING data relating to the movement of substances in the plant tissues have been obtained by the use of radioactive tracers and were reported at the Geneva Conference on the peaceful uses of atomic energy. Some of the more important findings from isotope tagging are as follows:

Movement of fluids in the plant is not slow, as had been thought. Products of photosynthesis usually reach the growing points in 20-40 minutes. They travel from leaves to roots at 70-100 cm. an hour and towards fruits and growing shoots at 40-60 cm. Phosphorus reaches leaves 15 or 20 minutes after the root has made contact with a fertiliser granule. When a root reaches a granule its capacity to absorb nutrients increases twenty- or thirty-fold and it can supply most of the whole plant's requirements.

Two to three days after a seed has germinated, the seedling's roots can reach phosphorus 3-4 cm. below it. If the fertiliser is placed 5-6 cm. to the side and the same distance below the seed, contact is delayed for 3 or 4 weeks. Vitamins and amino acids synthesised by soil micro-organisms are easily taken up by roots. Roots are also known to synthesise 14 amino acids. Carbon dioxide is absorbed by roots from the soil and translocated to the leaves, where its role in photosynthesis is as important as that of carbon dioxide from the air.

The "material handling" system in the plant is marvellous but not infallibly efficient. Low starch content of potatoes grown in North Russia was diagnosed as being due to interference in the flow of nutrients to the tubers by the products of carbon dioxide assimilation. Experiments to reduce this interference are an early essay in techniques for manipulating the composition and direction of plant fluids. The Russian scientists also claim success in promoting the growth of sugar-beet, cotton and cabbages by spraying nutrients on foliage—and also by fumigation.

SCIENCE NOTES AND NEWS

Study of Cell Growth

A plan of action has been submitted to the UNESCO by prominent biologists to encourage internationally or regionally, research on normal and abnormal cell growth.

In particular, it was suggested that an international committee be formed to collect information on research now in progress in this field, and to give assistance which would include not only the organization of meetings and the granting of scholarships, but also the establishment of breeding centres for laboratory animals. The establishment of a special laboratory for the study of plants and animals living under perfect conditions of humidity, temperature, radiation, etc., was also recommended. The biologists asked UNESCO to pay special attention to research on the frequency of different types of diseases according to regions.

International Atomic Energy Course for Management

The first international course on atomic energy to be conducted especially for business executives will be held February 27 through March 3 and repeated April 30 through May 5 at the Westchester Country Club, just outside of New York City. Consisting of lectures, demonstrations and discussions, the course will be taught by an outstanding faculty of scientists, engineers and businessmen. Enough time is set aside for informal sessions and small group discussions to assure each man attending an opportunity to explore subjects of particular interest to him. Also scheduled as part of the course is an extended tour of Brookhaven National Laboratory, one of the finest atomic research laboratories in the United States. Those wishing detailed information about these courses can obtain it by writing to the National Industrial Conference Board, 460, Park Avenue, New York City, or cabling NICBOARD, New York.

Endemic Fluorosis

Fluorosis of the skeleton results in increased density of bones, with formation of osteophytes, and calcification of ligaments, tendons, and interosseous fasciæ. All bones may be affected, but the changes are usually greatest in the vertebral column; when severe, they cause pain in the back, stiffness and limitation of spinal movements. Radiographs show diffuse osteosclerosis, with formation of new bone from periosteum and calcification of ligaments.

In Hyderabad-Deccan this field has so far remained unexplored from a clinical point of view, although fluorosis is prevalent in many parts. A paper by A. H. Siddiqui in the *British Medical Journal* (p. 1,408, Dec. 10, 1955), describes in detail the various clinical features of endemic fluorosis met with in Nalgonda District, with special reference to attendant neurological manifestations, both in human subjects and in animals.

Rauwolfias for Research

As announced earlier in this Journal (1955, 24, 323), M/s. Rajaranga & Co., Ltd., 5, Thambu Chetty Street, Madras-1, have given away their entire stock of *R. beddomei* and *R. micrantha* roots for investigational purposes.

They have however a surplus of 900 lb. of *R. serpentina* roots of West Coast origin and 400 lb. of the same of Nepalese origin for gratuitous distribution for clinical investigation, experimentation and scientific research in recognised hospitals, University or Research Laboratories, on request, on a F.O.R. Madras basis.

Symposium on Antibiotics

It has been arranged to hold a Symposium on Antibiotics—their production, utilization and mode of action, at Pimpri, sometime towards the end of March 1956, so that workers in this field could meet for a general discussion and exchange of views. The scope of the symposium will be as follows: Production and Technology, Chemistry and Biosynthesis, Mechanism of Action and Applications. Those who wish to participate in the Symposium are requested to contact Dr. A. Sreenivasan, Convener of the Steering Committee for the Symposium, and Professor of Biochemistry, Department of Chemical Technology, University of Bombay, Matunga Road, Bombay-19. Copies of papers (along with abstracts of about 300 words) should be sent to him by January 31, 1956. It is proposed to publish in the form of a brochure the various communications to the Symposium along with the discussions at the meeting.

Raptakos Medical Fellowships Award

The Raptakos Medical Research Board Fellowships for the year 1956 have been awarded to the following candidates: P. P. Nair (Institute of Science, Bombay), E. R. Divakaran (Presidency College, Calcutta-12), S. H. Kamath (Institute of Science, Bombay), Jitendra Sahay (Prince of Wales Medical College, Patna), and P. N. Chatterjee (Christian Medical College Hospital, Vellore, South India).

Bombay Natural History Society

The Bombay Natural History Society is now in a position to offer some financial assistance to carry out field work in natural history, including collection of specimens or data or the investigation of specific problems.

Applications should be addressed to: The Honorary Secretary, Bombay Natural History Society, 114, Apollo Street, Bombay, stating (1) the nature of the problem; (2) the experience and qualifications of the candidates, and (3) the amount required, with itemized details of how it is proposed to be spent. Applications should be received by the undersigned before 31st January 1956.

The Indian Botanical Society

At the Thirty-Fifth Annual General Meeting of the Indian Botanical Society held recently, the following were elected as office-bearers of the Society for 1956:

President: Dr. A. C. Joshi, Chandigarh; *Vice-Presidents*: Professors P. Maheshwari, Delhi; and Rev. Fr. H. Santapau, Bombay; *Secretary*: Prof. J. Venkateswarlu, Waltair; *Chief Editor, Business Manager and Treasurer*: Prof. T. S. Sadasivan, Madras.

National Institute of Sciences of India

The following were elected as office-bearers for 1956 at the Annual General Meeting held on 1st January:

President: Dr. A. Ukil (Calcutta); *Vice-Presidents*: Dr. K. R. Ramanathan (Ahmedabad) and Prof. S. P. Agharkar (Poona); *Treasurer*: Prof. D. S. Kothari (Delhi); *Foreign Secretary*: Prof. P. C. Mahalanobis (Calcutta); *Secretaries*: Prof. R. C. Majumdar (Delhi), Dr. B. P. Pal (Delhi); *Editor Publications*: Prof. J. M. Sen (Calcutta).

The following new Fellows were also elected:

Ordinary Fellows: Dr. J. N. Basu, Calcutta; Dr. J. N. Bhar, Calcutta; Dr. P. Bhattacharya, Izatnagar; Sri. V. Cadambe; New Delhi; Dr. R. N. Chakravarti, Calcutta; Prof. K. V. Giri, Bangalore; Sri. B. L. Gulatee, Dehra Dun; Dr. B. M. Johri, Delhi; Sri. S. L. Malurkar, Bombay; Dr. R. K. Pal, Calcutta; Dr. S. P. Ray-chaudhuri, Calcutta; Lt.-Col. Jaswant Singh, Delhi; Dr. Satya Swaroop, Switzerland; Dr. M. J. Thirumalachar, Pimpri. *Honorary Fellows*: Prof. Peter Kapitza, Moscow; Prof. Hans Adolf Krebs, Oxford; Prof. A. N. Nesmeyanov, Moscow; Prof. Hans Selye, Canada.

Indian Phytopathological Society

At the Annual General Meeting of the Indian Phytopathologial Society held recently at Agra, the following office-bearers were elected to the Council for 1956:

President: Dr. M. J. Thirumalachar; *Vice-President*: Dr. B. L. Chona; *Secretary-Treasurer*: Dr. R. Prasada (for 1956-58); *Councillors*: Dr. M. R. S. Iyengar, Dr. R. S. Mathur, Dr. S. Chowdhury, Dr. S. Vaheeduddin, Dr. M. K. Patel and Mr. K. M. Thomas.

Award of Research Degree

The University of Reading, England, has awarded the Ph.D. Degree in Botany to Mrs. S. D. Chitaley, of Nagpur, for her thesis entitled, "Contributions to the Knowledge of the Deccan Intertrappean Flora of India".

The University of Madras has awarded the Ph.D. Degree in Zoology to Shri K. N. Parameswaran for his thesis entitled, "Studies on *Enhydris dussumieri* (Smith)".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri K. A. Khasgiwale for his thesis entitled "Potentiometric Studies of Metal Amines, Double Salts and Metallic Soaps".

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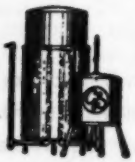

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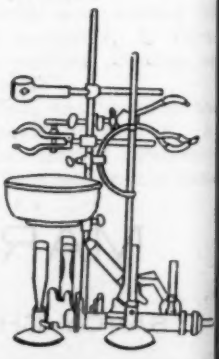

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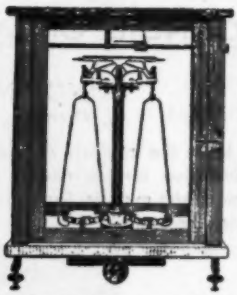

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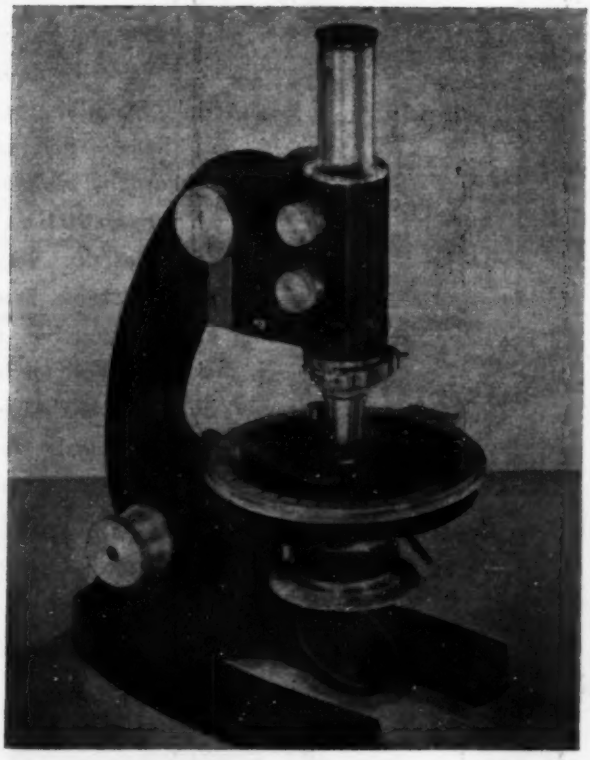

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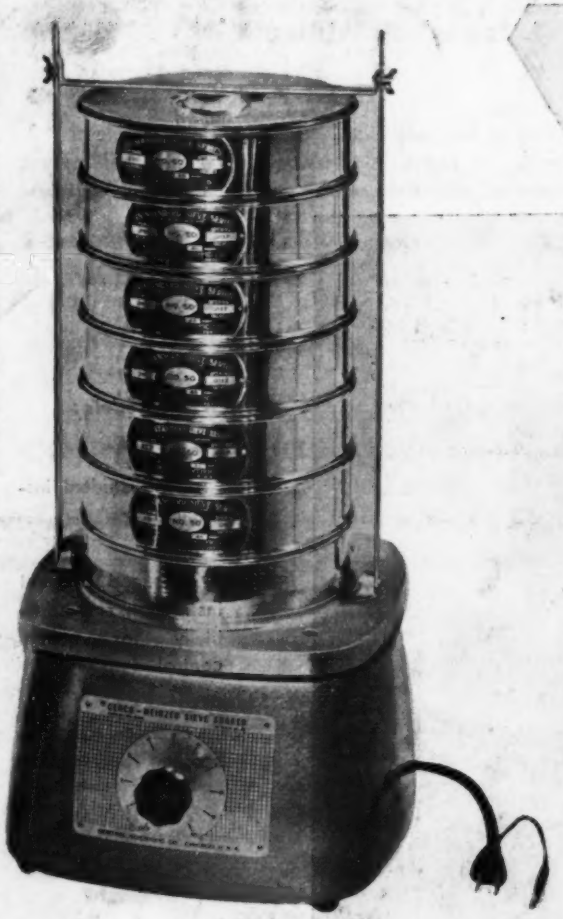

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